AN APPLICATION OF FUZZY LOGIC FOR A SHORT-TERM LOAD FORECAST OF MALAYSIA LOAD DEMAND

By

MOHD ADIKA BIN MOHAMED HASSAN

FINAL PROJECT REPORT

Submitted to the Electrical & Electronics Engineering Programme
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Electrical & Electronics Engineering)

Universiti Teknologi Petronas
Bandar Seri Iskandar
31750 Tronoh
Perak Darul Ridzuan

CERTIFICATION OF APPROVAL

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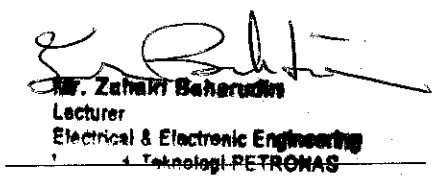
Approved:



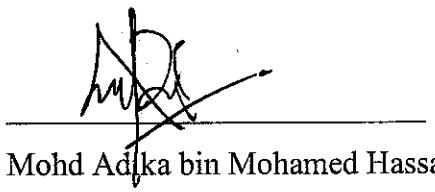
Mr. Zuhairi Baharudin
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

June 2005

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



Mohd Adika bin Mohamed Hassan

ABSTRACT

This project basically analyzes the hourly load profile in Malaysia. Studies on load pattern and trending apart the affecting factors on the electrical load demand have been performed. and application of fuzzy logic that being used from fuzzytech software to forecast the electrical load demand for 1 hour ahead and 19 hours ahead.

Chapter 1 basically describes some introduction of this project. Set of objectives is stated in order to ensure the project is done within the scope and time frame. The current situation is outlined as the problem statement which leads to relevancy apart its application in the practical world.

In order to ensure high quality of work being performed, some continuous research should be done. Apart of that, continuous study on load profile analysis and economical power analysis help much in this project. Basic knowledge of fuzzy logic in fuzzytech software also is one of the requirements while doing this project. Due to this condition, some of elementary information in doing this project being outlined in chapter 2 of this report. Meanwhile Chapter 3 describes the approach that has be done while doing this project. Some methods of designation of the system and outcome of the load profile studies is explained in this chapter.

As the project performed, the results and the outcomes of the system is presented in chapter 4. Apart of the result, some analysis such as error calculation and result analysis is shown here. Chapter 5 basically presents the importance and findings from this project. Some short summary of the project being outlined and some conclusion of the project. In Chapter 6, some recommendation to improve the project is discussed.

Digesting the report as a whole, it is basically explained the 19 hours and 17 hours load forecasting system that using fuzzy logic technique in fuzzytech software as an approach. With accuracy of the system around 97% - 98%, the system is reliable to be applied in practical world. Apart of that, this report also describes the capability of the system to forecast electrical load demand for 1 month ahead.

ACKNOWLEDGEMENTS

This project actually is not possible to be done without productive contributions and guidance of individuals and experts. First of all, I would like to thank my supervisor, Mr. Zuhairi Baharudin for giving me the opportunity by assigning me to this project and expose me to the load forecast technology world. His commitment, advices, guidance and interest are very meaningful to me.

Special gratitude goes to the technicians, ultimately to Ms. Siti Hawa; Final Year Project (FYP) technician, for her assistance and helpful co operation in the project research works. Not forget to Information Resource Center (IRC) executives who always assist me in gathering the information on this project. I am truly honored to their uncountable kindness.

This acknowledgement also dedicated to the TNB personnel, Ir. Fuad Jamaludin who has assists me in doing this project more practically and effectively . Not forgetting my colleagues and friends, especially Noorfiza Ayu Azmi, Shahril Iqmal, Juliana Zakaria, Imran Jumain, Sudiwana Sulong, Mohd Fadzli Fadzir, Mohd Firdaus Misroni, Khairil Azhar, Mohd Gauth, who also has given a great deal of contribution and moral support in performing this project.

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.

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LIST OF ABBREVIATIONS

UTP - Universiti Teknologi PETRONAS

TNB - Tenaga Nasional Berhad

STLF - Short term load forecast

LF - Load forecasting

Fz1 - fuzzy system for 19 hours ahead load forecast (from 0100 to 2000)

Fz2 - fuzzy system for 17 hours ahead load forecast (from 1200 to 0500 the next day)

RB - Rule block

FYP I - Final Year Project semester 1

FYP II - Final Year Project semester 2

CHAPTER 1
INTRODUCTION

1.1 Background

Load forecasting basically is vitally important in an electric industry. By having a good electric load forecasting, the generation of electricity can be made at its required level as the demand in the country. By maintaining that level, electric industry will make the optimum profit apart of creating reliability on the electric supply.

Nowadays, there are number of techniques and applications used to perform the electric load forecasting. From the usage of mathematical theories until today the application of some models is being used to generate a precise load forecasting data.

1.2 Problem statement

1.2.1 Problem identification

Generation of electrical energy basically can be done by using two sources which are renewable source such as wind, solar energy hydroelectric generation. The other source is from unrenewable source type for example coal, fuel and gas. These unrenewable sources basically have very high price. So in order to generate electricity using this type of source will consume very high cost. Due to this problem, supplying electrical energy which too high from demand will generate losses to the company. However, if the electric energy generated lower than demand, it will cause some damage in the electrical system. Responding to the issue, this project is carried out to predict a load trending so that the generation of electrical energy is always inline with the demand.

1.2.2 Significant of the project

By studying Malaysia's load demand, electrical load demand can be predicted and forecasted as accurate as possible. By having electrical load demand forecasted, generation of electricity can be optimized and the wastage of power can be reduced. However in order to maintain a reliable distribution of electrical power, surplus generation of electricity should be maintained. By having this, any local or small failure would not be affecting the whole system.

Apart of that, by having this project, fuzzy logic can be manipulated to forecast the electrical load demand. As known, fuzzy logic is one of intelligent system which might open other way of load forecast technique in the future.

1.3 Objectives

While doing this project, there are certain objectives that need to be achieved in order to determine the successfulness of the project. The objectives of the project are;

- Gain a reliable forecast or prediction data of electrical load demand for Malaysia seven days a week.
- Produce a system based on fuzzy logic (fuzzytech software) to do the load forecasting analysis.
- Develop a system that capable to forecast electrical load demand in Malaysia for 1 hour ahead and 19 hours ahead.
- Develop a good engineering ethics and exposed to a similar engineering work.

Besides of the objectives, there are also several items that have been set as scope of study in order to ensure the project is done in the right path. Basically, the scopes of study for this project are;

- Apply all the theories and knowledge that learned in electrical power system studies.
- Study and apply the fuzzy logic system through the fuzzytech software.
- Do some comparison between fuzzy logic with the other models used for load forecasting.

1.4 Relevancy of the project

This project is applicable for nowadays load generation and distribution system. The project aims at minimizing the electricity generation cost by minimizing the amount of power wastage during distribution. In the electrical generation plant, the prediction of raw material being used especially those from unrenewable source being optimized to reduce losses. Apart of that, by having good electrical load forecasting data may create a reliable electrical load distribution system. This is because whenever the demand of electricity is higher than generation, problem such as under voltage, over current might occur and damage the electrical equipment.

CHAPTER 2
LITERATURE REVIEW AND THEORY

2.1 Electrical load forecasting

Accurate models for electric power load forecasting are essential to the operation and planning of a utility company. Load forecasting helps an electric utility to make important decisions including decisions on purchasing and generating electric power, load switching, and infrastructure development. Load forecasts are extremely important for energy suppliers, financial institutions, and other participants in electric energy generation, transmission, distribution, and markets.

Load forecasts can be divided into three categories: short-term forecasts which are usually from one hour to one week, medium forecasts which are usually from a week to a year, and long-term forecasts which are longer than a year. The forecasts for different time horizons are important for different operations within a utility company. The natures of these forecasts are different as well. For example, for a particular region, it is possible to predict the next day load with an accuracy of approximately 3-5%. However, it is impossible to predict the next year peak load with the similar accuracy since accurate long-term weather forecasts are not available. It is also possible, according to the industry practice, to predict the weather normalized load, which would take place for average annual peak weather conditions or worse than average peak weather conditions for a given area. Weather normalized load is the load calculated for the so-called normal weather conditions which are the average of the weather characteristics for the peak historical loads over a certain period of time. The duration of this period varies from one utility to another. Most companies take the last 25-30 years of data. Load forecasting has always been important for planning and operational decision conducted by utility companies.

However, with the deregulation of the energy industries, load forecasting is even more important. With supply and demand fluctuating and the changes of weather conditions and energy prices increasing during peak situations, load forecasting is vitally important for utilities. Short-term load forecasting can help to estimate load flows and to make decisions that can prevent overloading. Timely implementations of such decisions lead to the improvement of network reliability and to the reduced occurrences of equipment failures and blackouts. Load forecasting is also important for contract evaluations and evaluations of various sophisticated financial products on energy pricing offered by the market.

2.2 Affecting factors on load forecasting

From the studies performed, electrical load demand can be identified as a non linear system which always changed depends on the factors that might affect on it. Basically there are 4 major factors that affect the electrical load demand. They are;

- Weather temperature
- Day type
- Special event or activities
- Time (hourly)

These 4 particulars will be fuzzificated (technique that used in order to design a fuzzy logic system) and included as the input while performing the fuzzy logic technique in the fuzzytech software

From the analysis done, shown that any increments of weather temperature will increase the electrical load demand. Figure below is a graph that shows the relationship between the weather temperature and the electrical load demand.

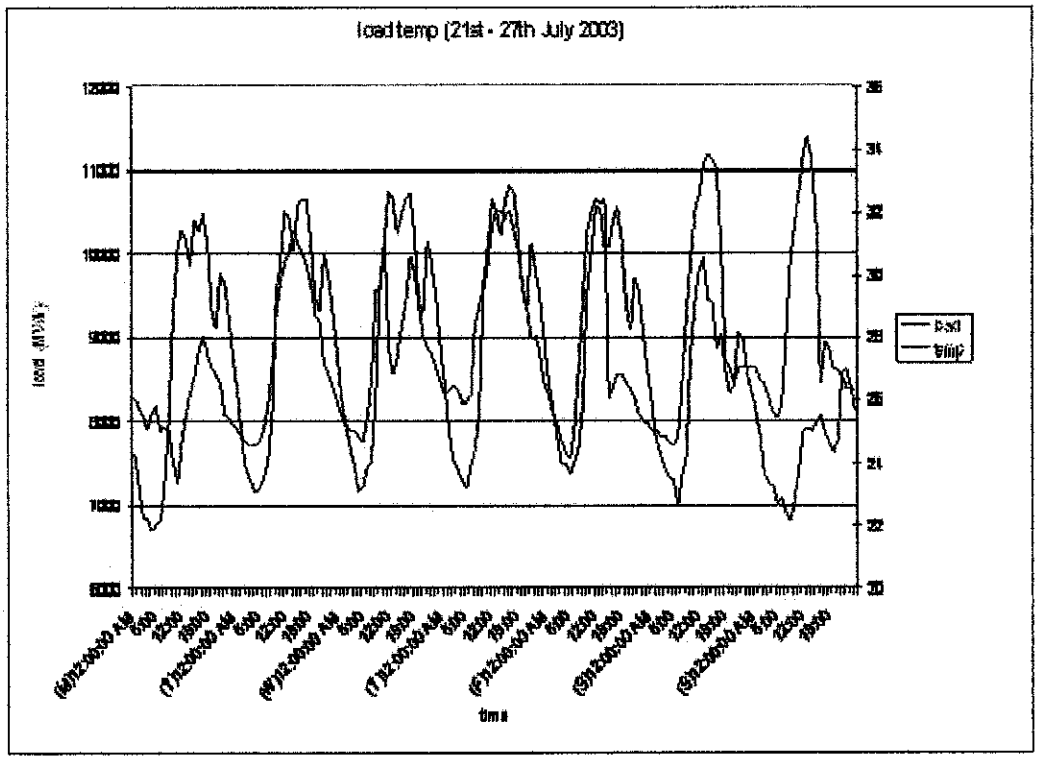


Figure 1 Relation between weather temperature and electrical load demand

Besides of the surrounding temperature, day also may contribute to the electrical trending. From studies, it can be said that electrical energy consumed higher in working days than holidays or weekend. This trending can be seen in figure below

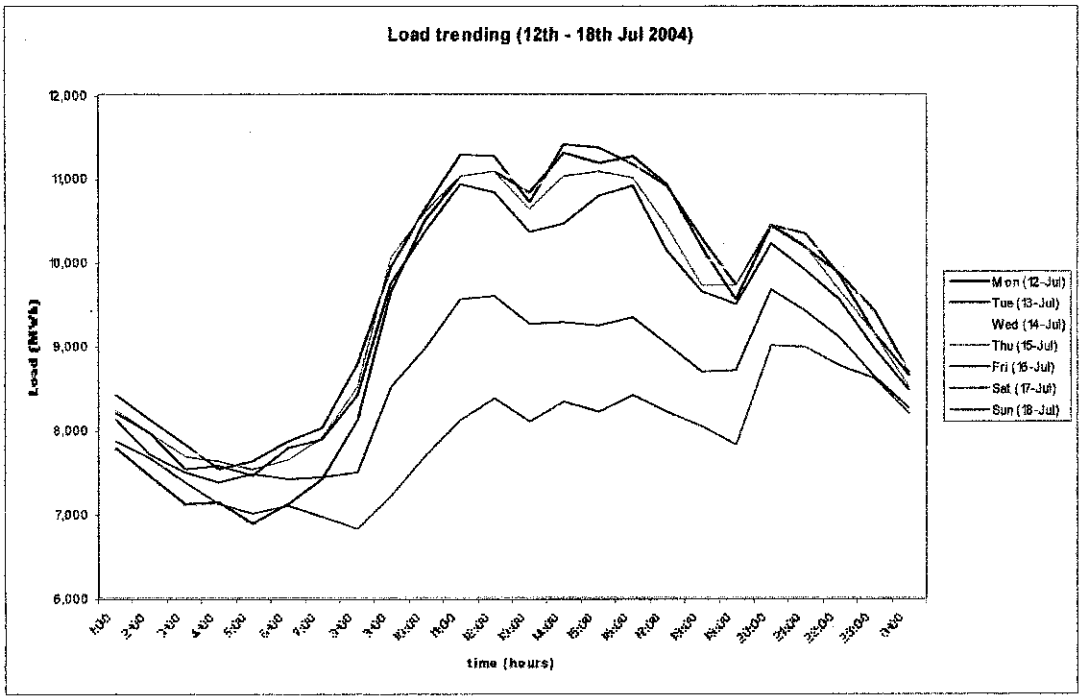


Figure 2 Electrical trending in a week vs time (12^{th} – 18^{th} July 2004)

From the figure 2 above, it can be seen that electrical consumption in working days (Monday – Thursday) is larger compared to weekend (Saturday and Sunday). In Friday, the trending is quite high but a little bit low since Kelantan district have their weekend on Friday.

2.3 Fuzzy logic (Fuzzytech software)

Fuzzytech basically is software that applies fuzzy logic technique to perform a system that developed by the user. The fuzzy logic can perform several task based on rules that decided or created by the user. The advantage of using fuzzy logic technique instead of previous way of load forecasting is its user friendly criteria. In previous day, load forecasting job is performed by those senior engineers who most of them had done the job for more than a decade. However, by developing a system in fuzzytech software, even a fresh graduate engineer will be able to perform the load forecasting job just by knowing several simple step or knowledge in fuzzy logic technique and fuzzytech software.

In the fuzzytech software, generally there are 3 basic steps to be performed in order to build a system or project. They are;

- Fuzzification
- Rules
- Defuzzification

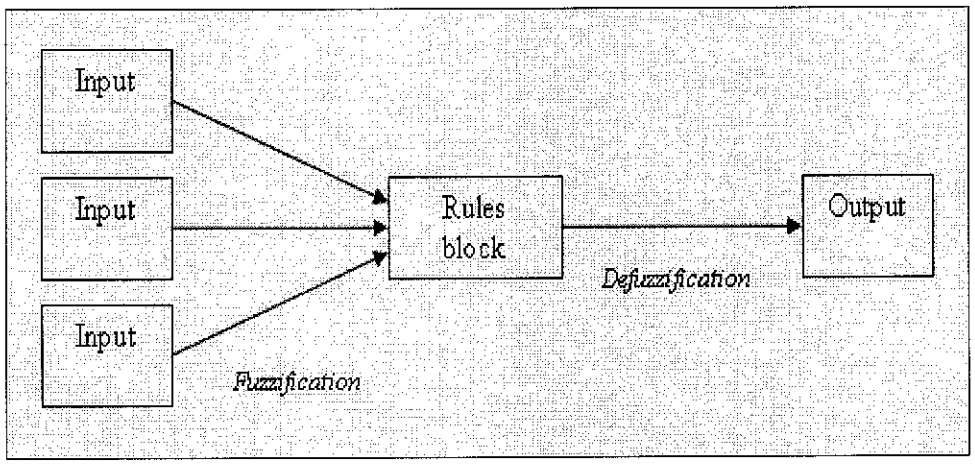


Figure 3 : Simplified diagram of work flow in fuzzytech software.

In fuzzification method is applied in order to determine a degree of validity for a certain problem or condition. This is actually work key in fuzzytech software in order to perform a fuzzy logic technique. This is because fuzzy logic technique is only can be applied the best in figure. By fuzzification method, the condition is changed or converted to figures in order to perform the fuzzy logic technique. For example, the determination of hot weather may invite some difficulties. By using fuzzification technique, a range of weather temperature will be assigned a number from 0 to 1 to justify its degree of validity for hot weather. Below is an example of fuzzification for weather temperature from 28°C to 38°C.

Table 1 : Example of fuzzification technique

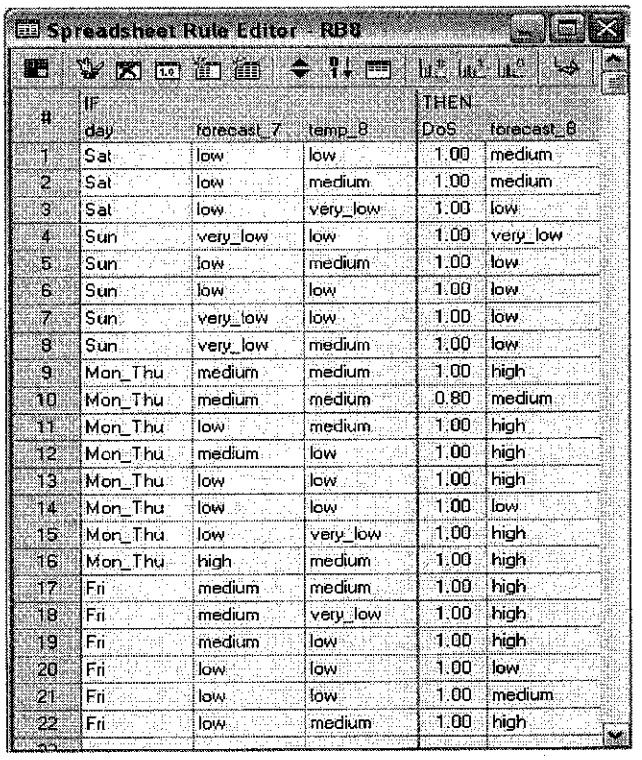
Weather temperature (°C)	Degree of validity (hot)
28	0.0
29	0.1
30	0.2
31	0.3
32	0.4
33	0.5
34	0.6
35	0.7
36	0.8
37	0.9
38	1.0

2.3.1 Fuzzy rules (if-then rules)

Generally fuzzy rules are created based on input-output pair of equation. In load forecasting, linguistic variable such as weather temperature, day, initial load demand will become the input of the system. The fuzzy forecasting model will be constructed using the model equation for example

If "Day" is Sunday AND "Initial load" is 7150 AND "weather temperature" is 25.4 THEN the "Forecast load demand" is 7300.

After fuzzification, then the data will be processed through a rule block. This rule block is created by the user based on fuzzy logic rules and the purpose of the project performed. For this project, the rule block is created to perform the load forecasting task. Figure below shows an example of fuzzy rules that created in fuzzy rule block.



Spreadsheet Rule Editor - RB8

#	IF day	forecast_7	temp_8	THEN DoS	forecast_8
1	Sat	low	low	1.00	medium
2	Sat	low	medium	1.00	medium
3	Sat	low	very_low	1.00	low
4	Sun	very_low	low	1.00	very_low
5	Sun	low	medium	1.00	low
6	Sun	low	low	1.00	low
7	Sun	very_low	low	1.00	low
8	Sun	very_low	medium	1.00	low
9	Mon_Thu	medium	medium	1.00	high
10	Mon_Thu	medium	medium	0.80	medium
11	Mon_Thu	low	medium	1.00	high
12	Mon_Thu	medium	low	1.00	high
13	Mon_Thu	low	low	1.00	high
14	Mon_Thu	low	low	1.00	low
15	Mon_Thu	low	very_low	1.00	high
16	Mon_Thu	high	medium	1.00	high
17	Fri	medium	medium	1.00	high
18	Fri	medium	very_low	1.00	high
19	Fri	medium	low	1.00	high
20	Fri	low	low	1.00	low
21	Fri	low	low	1.00	medium
22	Fri	low	medium	1.00	high

Figure 4 Sample of fuzzy rules that created in fuzzy rule block

After all the data is processed, then defuzzification technique is performed on the output data that created from the rule block. This is done in order to convert back the numerical value into a data that can be understood. In other words, defuzzification technique is the inverse of fuzzification technique.

2.4 Conventional methods of load forecasting

Most forecasting methods use statistical techniques or artificial intelligence algorithms such as regression, neural networks, fuzzy logic, and expert systems. Two of the methods, end-use and econometric approach are broadly used for medium- and long-term forecasting. A variety of methods, which include the similar day approach, various regression models, time series, neural networks, statistical learning algorithms, fuzzy logic, and expert systems have been developed for short-term forecasting. A large variety of mathematical methods and ideas have been used for load forecasting. The development and improvements of appropriate mathematical tools will lead to the development of more accurate load forecasting techniques. The accuracy of load forecasting depends not only on the load forecasting techniques, but also on the accuracy of forecasted weather scenarios.

In conventional methods, mathematical approach had been used broadly over the world. This approach basically assumed that electrical load trending as a non-linear system which can be replaced as a mathematical equation. However, these conventional approaches have several major disadvantages if compared with the intelligent system that being used nowadays. Some of the disadvantages are;

- Large error compared to intelligent system
    - Error of forecast result using mathematical approach about 5-8% compared to intelligent system about 3-4%
- Complex mathematical calculation
- Inherent limitation
    - Too many assumption did in the mathematical calculation
- Cannot adapt rapid changes

CHAPTER 3
METHODOLOGY

3.1 System design

In order to establish the fuzzy logic system in the fuzzytech software, some studies need to be performed in the first step. The leak of knowledge and experience as the system is used for the first time require some duration of time to be familiarized. After the system or software being studied and understood, than the electrical load forecast system is developed based on knowledge and data gathered in electrical load demand analysis step. Here the rules of fuzzy logic are created and adjusted to get the best forecasting data. Figure 2 below is a simplified diagram showing the system design approach.

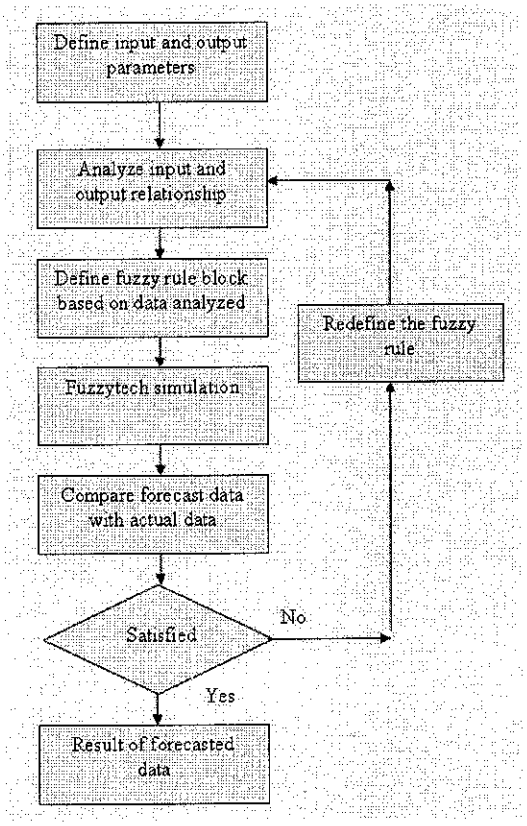


Figure 5 : Flowchart of system design approach

Basically, this project is performed in two major parts which are 1 hour ahead load forecast and 19 hours ahead load forecast. In first 6 month, the project is concentrated on doing the literature review and 1 hour ahead load forecast system. Then in following 6 month, 19 hours ahead load forecast system is developed

In order to ensure a good and practical system is developed, literature review done in many aspect. Basically the most interested aspects are

- Load profile analysis
- Electrical load demand in Malaysia
- Electrical generation and transmission in Malaysia
- Electrical load forecasting
- Approach that done previously in forecasting the electrical load
- Difference between conventional method and fuzzy system

Generally those are 6 major topics that have been studied and researched previously. By knowing them, the project flows become easier to be understood and performed. Apart of self research, there are planned meeting with the TNB's personnel who is a senior engineer that perform the load forecasting task for TNB in Malaysia. By having this meeting, much information on load forecasting and electrical load demand in Malaysia is gathered.

After a phase research and studies is performed, than the system on fuzzytech software is developed. Here, some real data will be analyzed in parallel as the research going on. This is done to ensure a high quality project is established and the successfulness of the project by applying as much knowledge in it.

Apart of the work flow, Gantt chart is also established in order to ensure the workflow is more systematic and organized. Besides, by having Gantt chart, the project progress can be monitored and at the same time ensure the completion of the project within the time frame planned. The Gantt chart for this project is attached in the appendix.

3.2 Temperature analysis

As stated in chapter 2, weather temperature is one of the main factors that affect the result of load forecast data. For this project, temperature from Subang is considered as on of the input that my affect the load forecasting result. This is because Subang is one of the cities that have very high electrical load demand in Malaysia. Apart of that, location of Subang which are in the middle of Peninsula Malaysia can be referred as average Malaysia's weather temperature

3.3 Load forecast system

In this project, there are three types of load forecast system was designed. They are;

- 1 hour ahead load forecast
- 19 hours ahead load forecast
- 1 month ahead load forecast

1 hour ahead load forecast actually is a basic system of load forecast. By having this system, it can be applied into more practical system which is 19 hours ahead load forecast system.

3.3.1 1 hour ahead load forecast

For 1 hour ahead load forecast system, studies on power analysis of Malaysia load demand is done. As stated in chapter 2, fuzzy system in the fuzzytech software is created based on the history data that set as the rule of the system. In this case, electrical load demand and temperature data of Malaysia in July 2003 was studied and analyzed.

After sufficient data gathered, the fuzzy logic system is developed in fuzzytech software to forecast the electric load demand. This process is started from determination of input data. For 1 hour ahead load forecast system, there are three facts that were put in considered as the system input data which are;

- Time
- Current load
- Current temperature

After the input of the system is determined, they need to be converted into fuzzy data first for the system understands them. In this case, fuzzification method is performed to those data. After determination of the input parameters, then the rule block is generated based on history data that have been studied. The rules are developed based on the time-temperature-current load condition. Basically, the fuzzy system will looks like figure below.

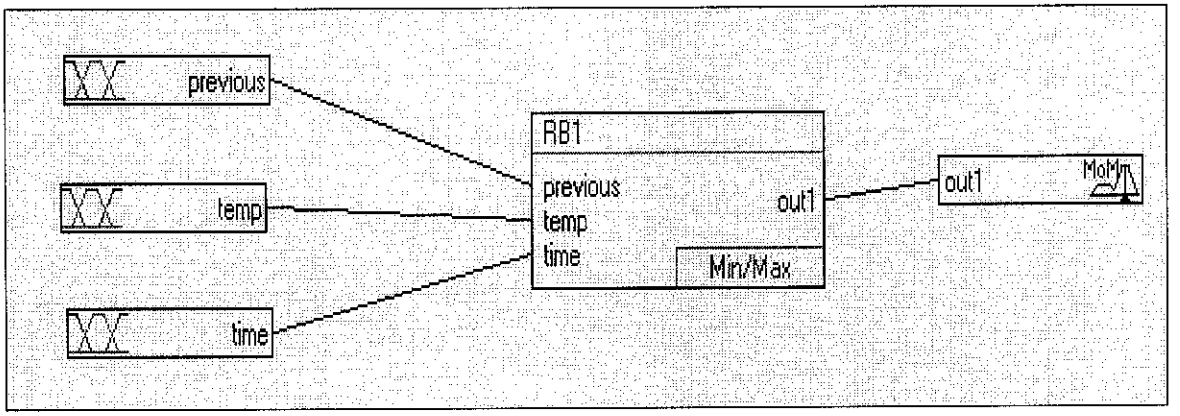


Figure 6 : Fuzzy system that developed for electrical load forecasting

3.3.2 19 and 17 hours ahead load forecast

19 hours ahead load forecast basically is an advance design from the 1 hour ahead load forecast that was designed previously. This system is design in order to fulfill the practical requirement of load forecasting in the real world. Commonly, the electric load is forecasted in 24 hours set of data. Figure 4 and figure 5 below showing the time frame of the fuzzy system that designed.

Basically this system is designed in two parts which is Fz1 (19 hours ahead load forecast) which is capable to forecast the electric load demand from 0200 hours until 2000 hours. This system will only use point of current load demand at 0100 hours and forecasted hourly temperature data. Meanwhile the second part of the system is called Fz2 (17 hours ahead load forecast) which is used to forecast the electric load demand from 1300 hours until 0400 hours the next day by using current load demand at 1200 hours and forecasted hourly temperature data.

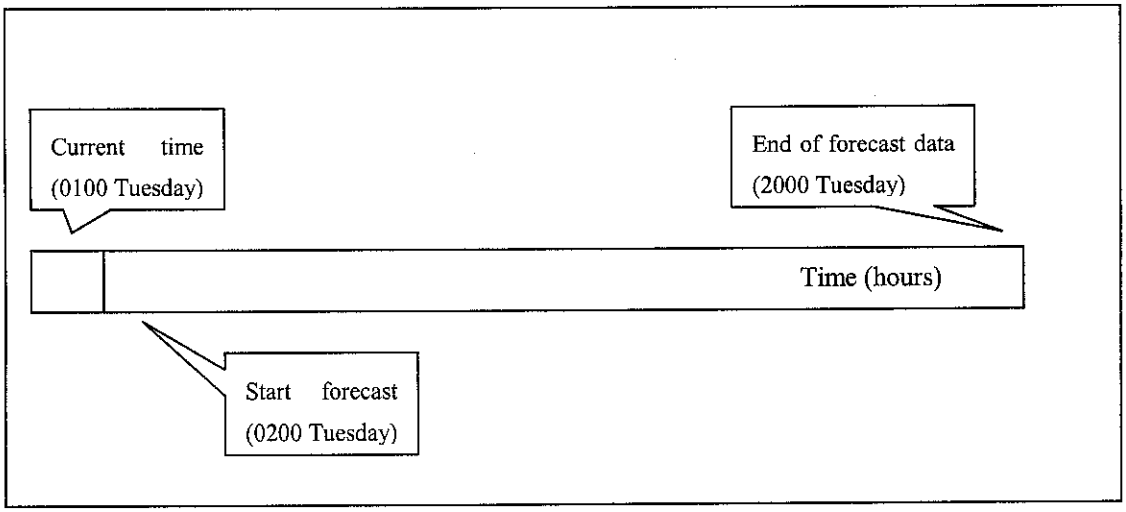


Figure 7 Timeline of target forecast data for 19 hours ahead load forecast part 1 (Fz1)

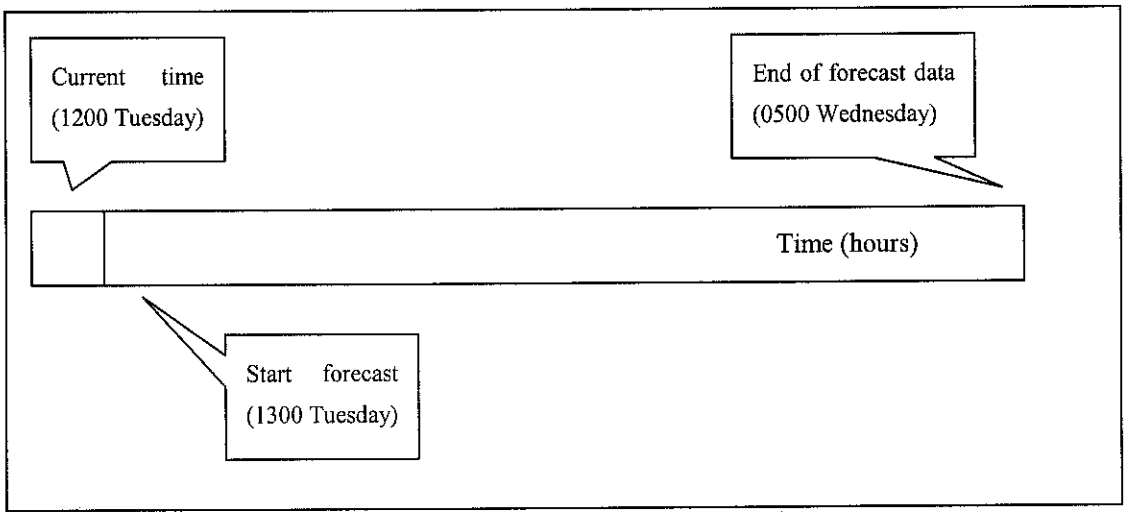
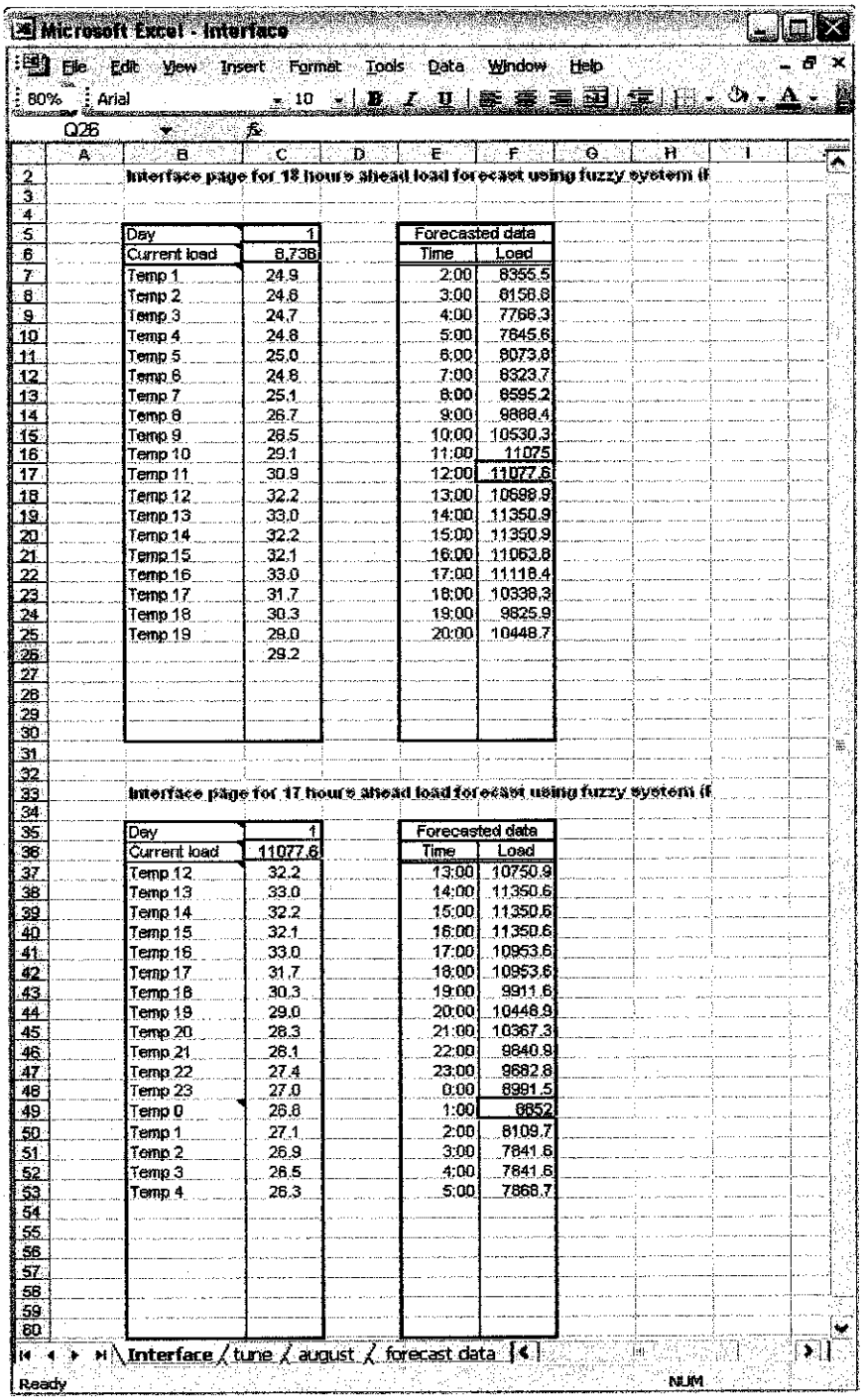


Figure 8 Timeline of target forecast data for 19 hours ahead load forecast part 2

3.3.3 1 month ahead load forecast

This system basically uses the same model as 19 hours ahead load forecast. The difference is in this system, it uses the forecasted data as for every point of input required in the system. So in this case, the input data that used in this system is only actual data at 0100 hours on 1st July 2004 and forecasted hourly temperature data for the whole month to forecast the hourly electric load demand in next 30 days period. Figure of interface page below would explain better on the application of the system.



Microsoft Excel - Interface

File Edit View Insert Format Tools Data Window Help

80% Arial 10

Q26

Interface page for 18 hours ahead load forecast using fuzzy system if

Day	1
Current load	8,738
Temp 1	24.9
Temp 2	24.8
Temp 3	24.7
Temp 4	24.8
Temp 5	25.0
Temp 6	24.8
Temp 7	25.1
Temp 8	26.7
Temp 9	28.5
Temp 10	29.1
Temp 11	30.9
Temp 12	32.2
Temp 13	33.0
Temp 14	32.2
Temp 15	32.1
Temp 16	33.0
Temp 17	31.7
Temp 18	30.3
Temp 19	29.0
	29.2

Forecasted data	
Time	Load
2:00	8355.5
3:00	8158.8
4:00	7766.3
5:00	7645.6
6:00	8073.8
7:00	8323.7
8:00	8595.2
9:00	9868.4
10:00	10530.3
11:00	11075
12:00	11077.6
13:00	10698.9
14:00	11350.9
15:00	11350.9
16:00	11063.8
17:00	11118.4
18:00	10338.3
19:00	9825.9
20:00	10448.7

Interface page for 17 hours ahead load forecast using fuzzy system if

Day	1
Current load	11077.6
Temp 12	32.2
Temp 13	33.0
Temp 14	32.2
Temp 15	32.1
Temp 16	33.0
Temp 17	31.7
Temp 18	30.3
Temp 19	29.0
Temp 20	28.3
Temp 21	28.1
Temp 22	27.4
Temp 23	27.0
Temp 0	26.6
Temp 1	27.1
Temp 2	26.9
Temp 3	26.5
Temp 4	26.3

Forecasted data	
Time	Load
13:00	10750.9
14:00	11350.6
15:00	11350.6
16:00	11350.6
17:00	10953.6
18:00	10953.6
19:00	9911.6
20:00	10448.9
21:00	10367.3
22:00	9840.9
23:00	9682.8
0:00	8991.5
1:00	8652
2:00	8109.7
3:00	7841.6
4:00	7841.6
5:00	7868.7

Interface / tune / august / forecast data

Ready NUM

Figure 9 Interface page used for 1 month ahead load forecast

As stated before, for 1 month ahead load forecast, it's only take point of current load demand at 0100 hour on 1st July 2004 and the forecasted temperature data for Fz1 system. By using this data, the system is able to forecast the electrical load demand for the next 19 hours. By using this forecasted data, result at 1200 hour is taken and implemented into Fz2 model (green highlighted box). Here, the system is capable to

forecast the electrical load demand for the next 17 hours until 0400 hour of the next day. As done before, here the forecasted data at 0100 hour is taken back and implemented to the Fz1 model to forecast the next load demand (blue highlighted box). This chain activity is applied until result of forecasted data for the whole month is obtained.

3.4 Fuzzy system

In designing the system of 19 hours ahead load forecast, steps that used for designing 1 hour ahead load forecast is repeated. However due to additional value of result, more detail study on previous or history data should be done. Here electrical load of Malaysia and temperature data of Subang for May until June 2004 is studied. By using these analysis data, this system is expected to forecast the load demand for period of July until September 2004.

Apart of additional input data analysis, some modification of the fuzzy system also performed in order to ensure its capability of forecasting 19 hours ahead load demand. In this system, fuzzy rule blocks are connected in series by using the previous forecasted load. For example, fuzzy rule block 1 (RB1) will generate result of forecasted load for time at 0200 hours. The second rule block (RB2) will use the forecasted load from RB1 as its input in order to forecast the electric load at time 0300 hours. Figure below shows the architecture of fuzzy system that designed for 19 hours and 17 hours ahead load forecast.

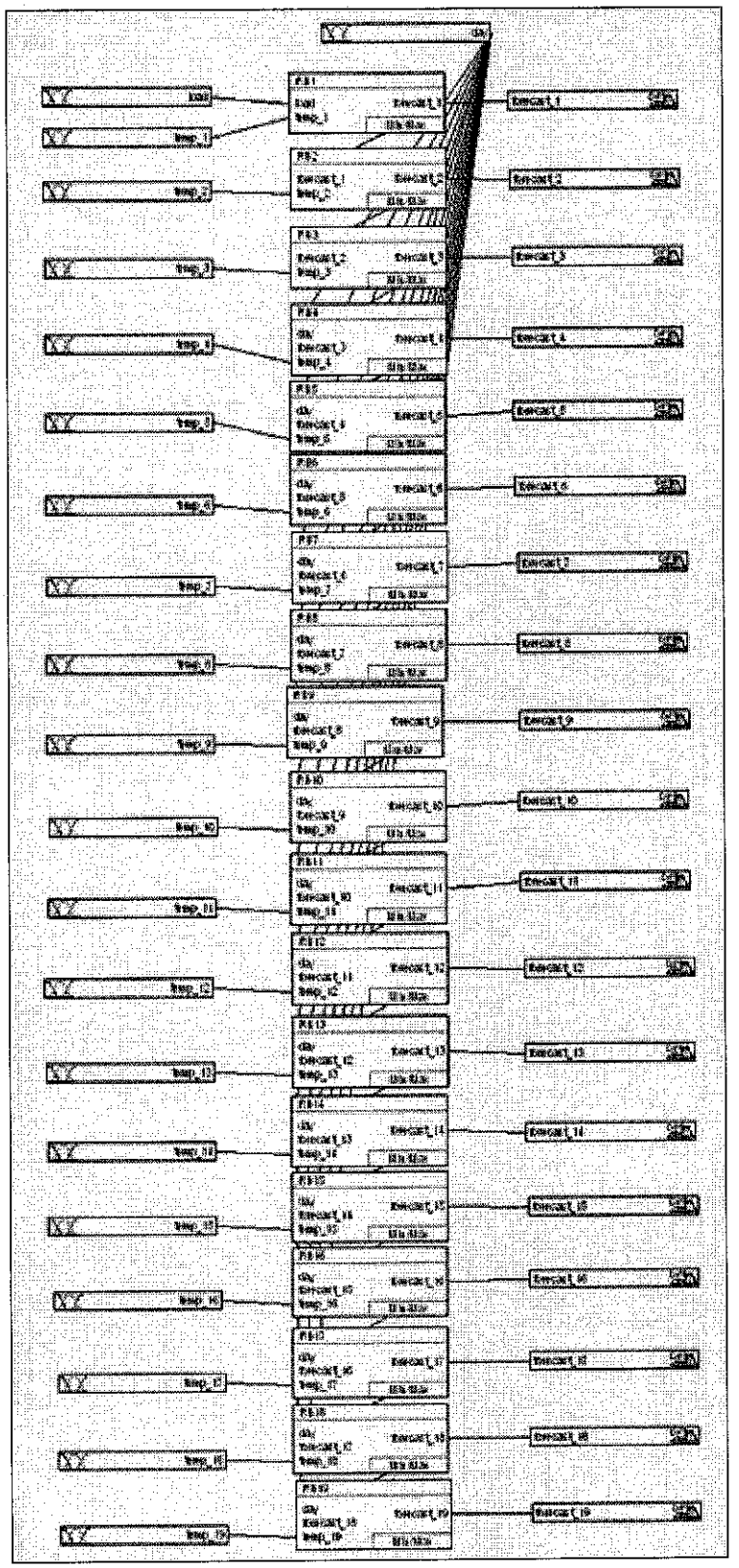


Figure 10 Fuzzy model architecture for Fz1 (19 hours ahead load forecast system)

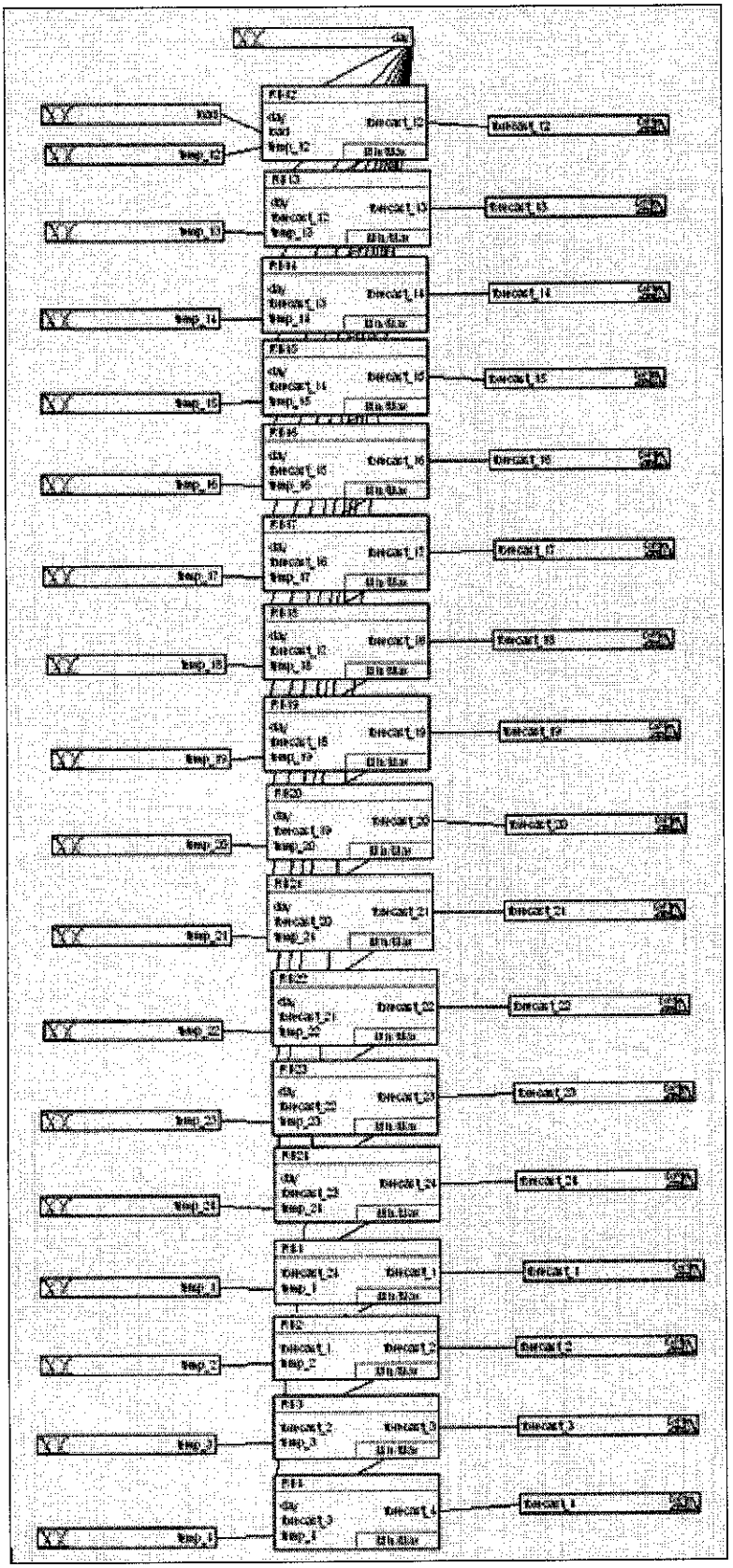


Figure 11 Fuzzy model architecture for Fz2 (17 hours ahead load forecast system)

3.4.1 Fuzzy inputs

In 19 hours ahead load forecast system, basically there are 3 factors that considered as the membership function of the fuzzy system (fuzzy input). They are;

- Day type
- Weather temperature
- Initial load demand

These 3 inputs are converted into fuzzy data using fuzzification method. Here, each term is assigned a number so that it can be understood by the fuzzy. The fuzzy number assignation is as below;

- Monday – Thursday (1)
- Friday (2)
- Saturday (3)
- Sunday (4)

Figure below shown membership function of day type in the fuzzy model.

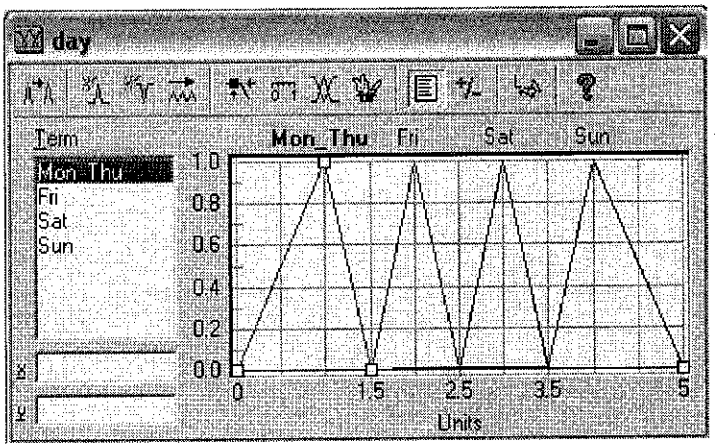


Figure 12 Membership function of day type

For the second input which is weather temperature, the data is divided into 5 terms as below

- Very low : (21°C – 24.2°C)
- Low : (24.3°C – 25.8°C)
- Medium : (25.9°C – 29°C)
- High : (29.1°C – 33.8°C)
- Very high : (33.9°C – 37°C)

Figure below shows membership function of weather temperature input data.

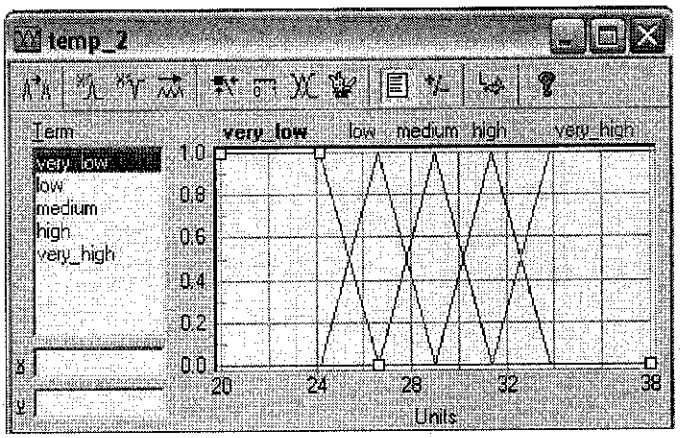


Figure 13 Membership function for temperature

This data actually attached to each rule blocks which is designed based on hourly basis. In order to do the electrical load forecasting task, the user need to know the forecast weather temperature data in the first place.

For the third input which is initial load demand, the data is also divided into 5 terms which are;

- Very low : (6000MW – 7300MW)
- Low : (7301MW – 8600MW)
- Medium : (8601MW – 9900MW)
- High : (9901MW – 11200MW)
- Very high : (11201MW – 12500MW)

Figure below shows membership function of initial load demand input data

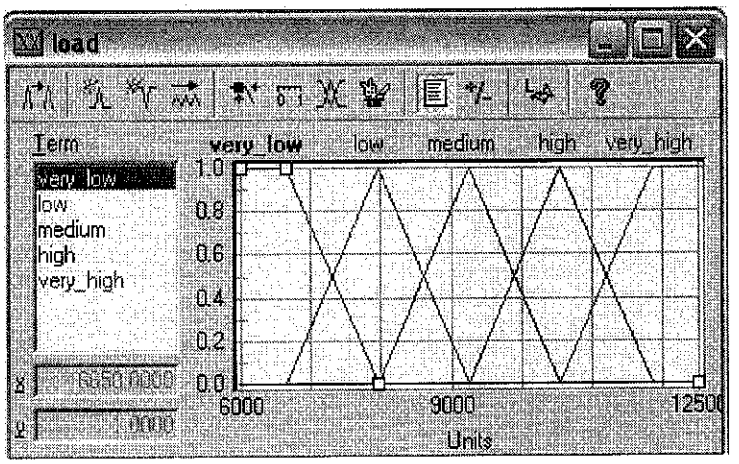


Figure 14 Membership function of initial load demand

For this system, the input data is required as the initial point of forecasting task. As stated previously, the system is divided into 2 parts. For the first part (part 1) the electrical load demand at 0100 is required as the initial input data to forecast the hourly electrical load demand until 2000. Meanwhile for second part of the system (part 2) electrical load demand at 1200 is required in order perform the hourly forecasting task until 0400 on the next day.

3.4.2 Fuzzy rules

The fuzzy rules basically represent the knowledge of the system. Linguistic variable is used as the vocabulary to express the control strategy of a fuzzy logic controller. In this project, basically there are about 19 rule blocks design for part 1 of the system and 17 rule blocks for part 2. Number of rules created for each rule block depends on the input variable and the accuracy needed for each forecast result. Basically, increment of rules used for each rule block will increase the accuracy of the system. However, additional unnecessary rules will increase the memory size used by the system which will increase the cost of the system. Figure below is an example of fuzzy rules that created in the fuzzy rule block.

Spreadsheet Rule Editor - RB14

#	IF day	forecast_13	temp_14	THEN DoS	forecast_14
1	Sat	high	very_high	1.00	medium
2	Sat	high	very_high	1.00	high
3	Sat	high	low	1.00	medium
4	Sat	high	high	1.00	medium
5	Sat	low	high	1.00	low
6	Sat	medium	medium	1.00	medium
7	Sat	medium	low	1.00	medium
8	Sun	low	very_high	1.00	low
9	Sun	medium	very_high	1.00	medium
10	Sun	low	medium	1.00	low
11	Sun	low	very_high	1.00	medium
12	Mon_Thu	very_high	very_high	1.00	very_high
13	Mon_Thu	very_high	high	1.00	very_high
14	Mon_Thu	medium	high	1.00	medium
15	Mon_Thu	very_high	medium	1.00	very_high
16	Mon_Thu	high	low	1.00	high
17	Mon_Thu	high	low	1.00	very_high
18	Mon_Thu	high	very_high	1.00	very_high
19	Mon_Thu	very_high	medium	1.00	high
20	Fri	high	very_high	1.00	very_high
21	Fri	high	medium	1.00	high
22	Fri	high	low	1.00	high
23	Fri	high	very_high	1.00	high
24	Fri	high	high	1.00	high
25					
26					

Figure 15 Fuzzy rules for time at 1400 hours that created in the fuzzy system

3.5 System tuning

After the system is designed and the result is generated, then some analysis is performed on the forecasted load. Basically the result of forecasted load will be compared with the actual load in order to justify the accuracy and percentage of error that generated by the system. By doing this analysis, the fuzzy rules can be tuned again in order to achieve the best accuracy and lowest error percentage. In this project, the tuning task is performed by using 3 ways below;

- Tune the rules' degree of validity
- Tune the membership of functions' highest point
- Review fuzzy rules

By performing the tuning task, errors that occur in the system are reduced. In the initial state of the system, error of forecasted data with the actual data is about 10% to 12%. However, after some revision done on the system, percentage of error is reduced below 4%

3.6 Interface

In order to make the designed system is much user friendly, an interface model is created using *Microsoft Excel* program. Here, a worksheet is linked by using DDE Links function that available in the Fuzzytech software. By fill in the desired data that required as the fuzzy system designation, user might perform the load forecasting task by using *Microsoft Excel* as it interface. Figure below shows the interface worksheet that created for the fuzzy model.

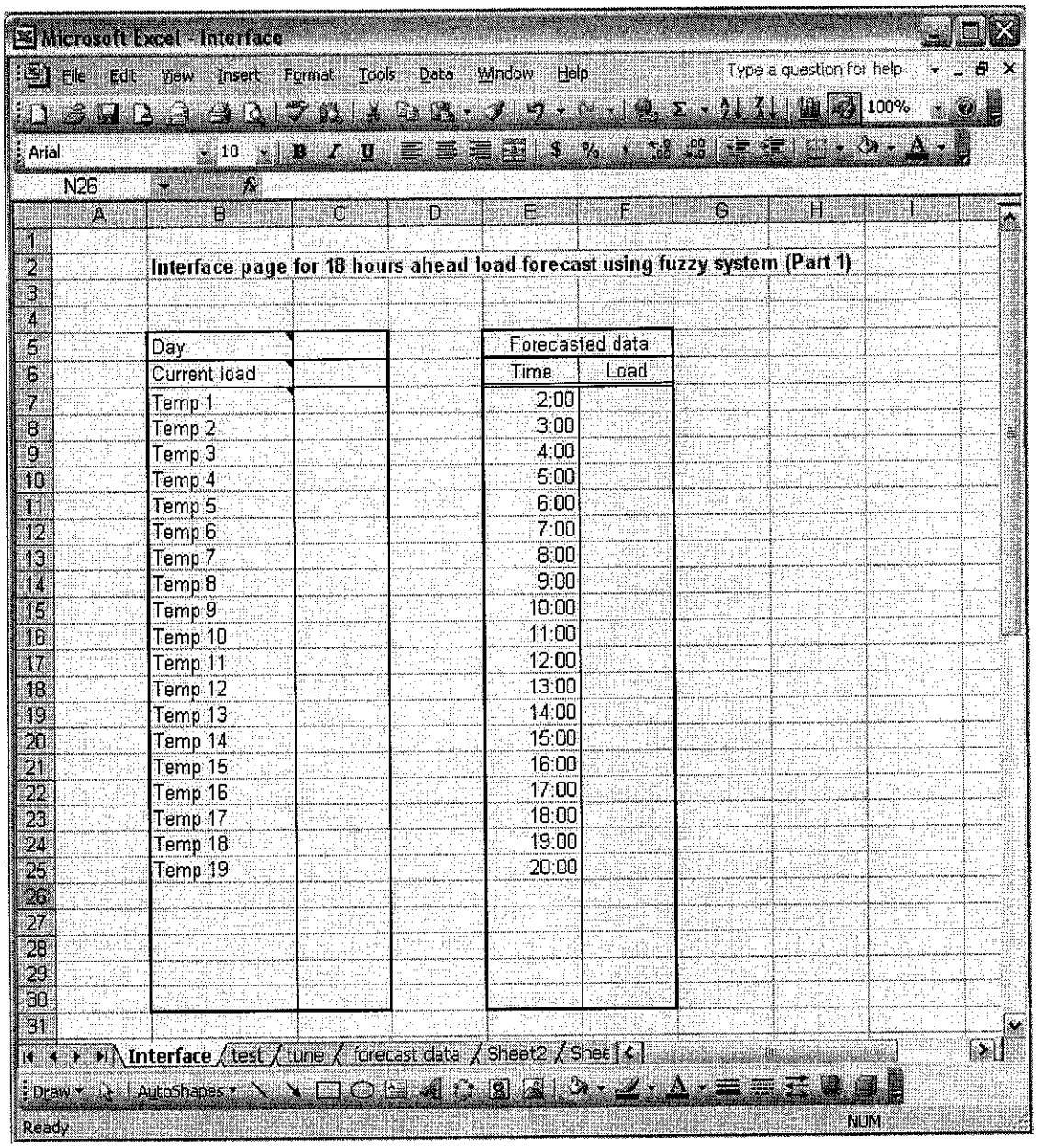


Figure 16 Interface page for fuzzy system part 1 (Fz1)

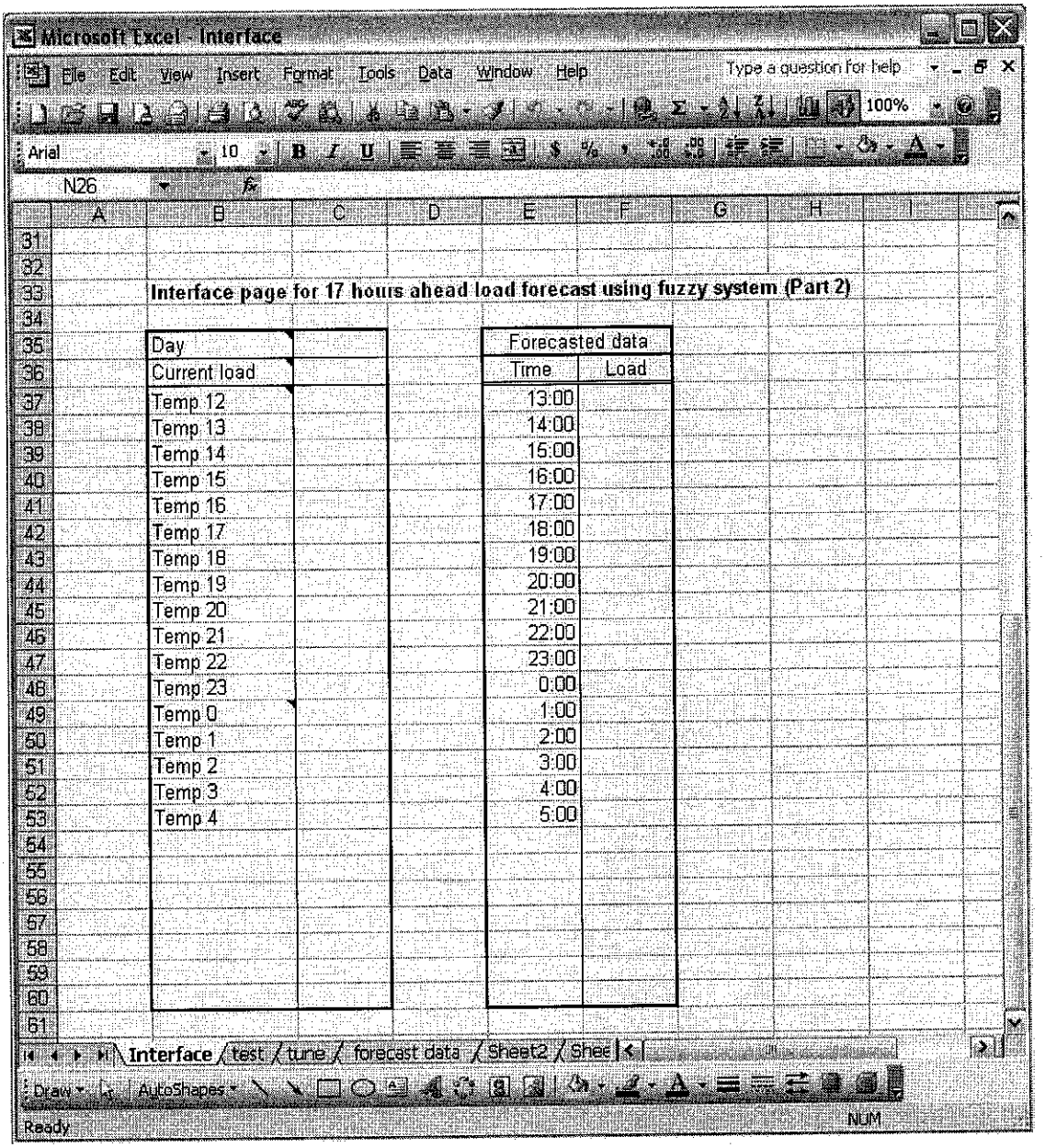


Figure 17 Interface page for fuzzy system part 2 (Fz2)

3.7 Error Analysis

In order to ensure the accuracy and reliability of the forecasted data, some error analysis is performed. The error of each hour forecasted data is simply calculated by using formula below;

$$Forecast\ error(\varepsilon) = \frac{Forecasted\ data - Actual\ data}{Actual\ data} \times 100\%$$

In this system, error is calculated based on each part of the fuzzy model which is part 1 and part 2 of the system. For part 1 (Fz1), average error of the day is calculated as

$$Average\ error = \frac{\sum |(\varepsilon_1 + \varepsilon_2 + \varepsilon_3 + ... + \varepsilon_{20})|}{19}$$

Where ε is representing electrical load demand and a desired time. In this case, the error at time 0100 hours until 2000 hours is taken into consideration and the average value is calculated.

For fuzzy model of part 2 (Fz2) of the system, average error is calculated as

$$Average\ error = \frac{\sum |(\varepsilon_1 + \varepsilon_2 + \varepsilon_3 + \varepsilon_4) + (\varepsilon_{12} + \varepsilon_{13} + \varepsilon_{14} + ... + \varepsilon_{24})|}{17}$$

This is done due to forecast data from 0100 until 0400 is generated by previous day (day_{n-1}) of fuzzy model. Table below shows error calculation done for forecast result on Tuesday, 13th July 2004

Table 2 Error calculation done on forecast result for Tuesday (13th July 2004)

		time	temperature	actual load	forecast Fz1	Forecast Fz2	Err Fz1	Err Fz2
Tuesday	13-Jul-04	1:00	25.8	8,419	-	8852	-	5.14
		2:00	25.3	8,121	7938.7	8103.4	2.24	0.22
	Fz1 % err 1.08	3:00	25.2	7,824	7841.6	7841.6	0.22	0.22
		4:00	25.0	7,532	7724.3	7724.3	2.55	2.55
		5:00	24.2	7,623	7419.1	7419.1	2.67	2.67
	Fz2 % err 1.25	6:00	24.1	7,854	7942.3	-	1.12	-
		7:00	24.4	8,019	7948.5	-	0.88	-
		8:00	27.0	8,790	8594.6	-	2.22	-
		9:00	29.2	9,936	9887	-	0.49	-
		10:00	30.9	10,628	10533.7	-	0.89	-
		11:00	30.4	11,276	11349.5	-	0.65	-
		12:00	30.7	11,264	11349.5	-	0.76	-
		13:00	30.3	10,698	10698.1	10785	0.00	0.81
		14:00	28.8	11,396	11349.5	11356.5	0.41	0.35
		15:00	25.2	11,346	11353.4	11362.5	0.07	0.15
		16:00	25.1	11,153	11202.3	11181.3	0.44	0.25
		17:00	25.5	10,910	11091.7	10894.8	1.67	0.14
		18:00	23.4	10,273	10156.2	10108.6	1.14	1.60
		19:00	23.2	9,735	9636.5	9683.3	1.01	0.53
		20:00	23.3	10,438	10550	10550	1.07	1.07
		21:00	23.4	10,326	-	10550	-	2.17
		22:00	23.5	9,848	-	9683.3	-	1.67
		23:00	23.6	9,131	-	9242.6	-	1.22
		0:00	23.7	8,645	-	8600	-	0.52

Here error calculation for forecasted data for 19 hours ahead load forecast (Fz1) is calculated by using data in the green highlighted box meanwhile error calculation data for Fz2 is taken from blue highlighted box.

3.7.1 Intercept error calculation

In the fuzzy model that designed, there is an interception of output data generated. The intercept data is at 0200 hours to 0500 hours and the other part is at 1300 hours to 2000 hours. Here some error generated from both model at particular data (data that intercept between Fz1 and Fz2) is compared and analyzed. By performing this task, the best model is taken to have priority at any point of interception.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Results of 19 hours ahead and 17 hours ahead load forecast system

After the system is developed, then some experiment is done in order to test the reliability and accuracy of the system. Basically, the test is performed by comparing the forecast data using the fuzzy system with the actual value. Graphs and table below show the experiment result which are taken from forecast data on Sunday (4^{th} July 2004) until Saturday (10^{th} July 2004).

Here, fz1 graph represent the output result from 19 hours ahead load forecast system (0200 until 2000) meanwhile fz2 graph represent the output data for 17 hours ahead load forecast system (1300 until 0400 the next day). Actual graph represent the actual value of electrical load demand at the particular time. Full result of the forecasted data is attached in the appendix.

Table 3 Forecast result and error calculation on Sunday (4th July 2004)

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Sunday	4-Jul-04	1:00	26.4	8,365		8228.6		1.63
		2:00	26.2	8,169	7916.7	8085.5	3.09	1.02
	Fz1 % err	3:00	26.2	7,894	7841.6	7841.6	0.66	0.66
	1.25	4:00	26.0	7,677	7841.6	7841.6	2.14	2.14
		5:00	25.7	7,500	7868.7	7868.7	4.92	4.92
	Fz2 % err	6:00	25.5	7,650	7594.8		0.72	
	1.76	7:00	25.3	7,387	7322.9		0.87	
		8:00	26.4	7,156	7137.5		0.26	
		9:00	28.3	7,556	7560		0.05	
		10:00	29.9	7,832	8141.3		3.95	
		11:00	31.3	8,257	8350.9		1.14	
		12:00	32.3	8,387	8383.3		0.04	
		13:00	32.6	8,533	8481.8	8106.8	0.60	4.99
		14:00	33.4	8,673	8600	8600	0.84	0.84
		15:00	31.9	8,562	8600	8600	0.44	0.44
		16:00	26.2	8,440	8383.4	8383.4	0.67	0.67
		17:00	25.3	7,988	7803.8	7803.8	2.31	2.31
		18:00	25.4	7,929	7950	7950	0.26	0.26
		19:00	24.6	8,147	8169.3	8169.3	0.27	0.27
		20:00	24.0	8,991	9030.7	9030.7	0.44	0.44
		21:00	24.6	8,962		9250		3.21
		22:00	24.2	8,810		8903.3		1.06
		23:00	24.1	8,706		8600		1.22
		0:00	23.7	8,285		8600		3.80

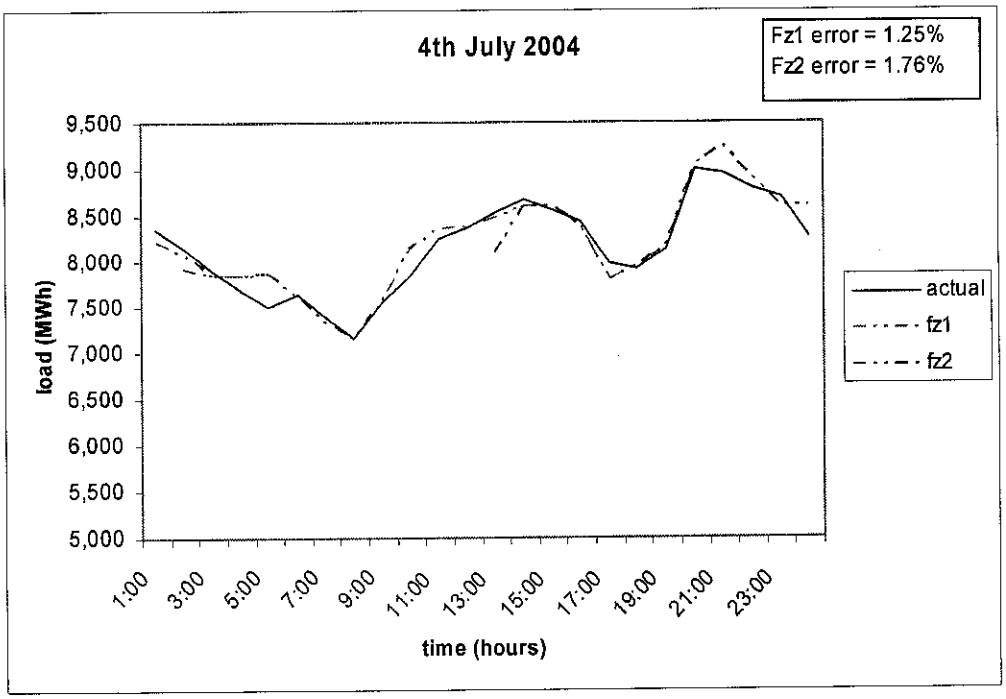


Figure 18 Comparison of Saturday (4th July 2004) forecast data and actual data

Table 4 Forecast result and error calculation for Monday (5th July 2004)

date		time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Monday	5-Jul-04	1:00	23.7	7,804		7950		1.87
		2:00	23.6	7,626	7675.7	7675.8	0.65	0.65
	Fz1 % err	3:00	23.5	7,374	7137.5	7559.8	3.21	2.52
	2.08	4:00	23.4	7,409	7137.5	7559.8	3.66	2.04
		5:00	23.4	7,307	7137.5	7137.5	2.32	2.32
	Fz2 % err	6:00	23.4	7,466	7940.6		6.36	
	1.37	7:00	23.9	7,580	7948.2		4.86	
		8:00	26.1	8,363	8593.5		2.76	
		9:00	27.6	9,909	9884.1		0.25	
		10:00	29.0	10,678	10523.2		1.45	
		11:00	30.1	11,149	11069.1		0.72	
		12:00	30.9	11,278	11072.4		1.82	
		13:00	32.1	10,803	10473.2	10801.8	3.05	0.01
		14:00	31.7	11,317	11346.6	11346.7	0.26	0.26
		15:00	26.4	11,507	11346.6	11346.7	1.39	1.39
		16:00	25.7	11,426	11221	11221.2	1.79	1.79
		17:00	24.4	11,047	11267.2	10981.1	1.99	0.60
		18:00	24.9	10,242	10108.4	10108.5	1.30	1.30
		19:00	25.1	9,705	9759.3	9757.6	0.56	0.54
		20:00	25.3	10,640	10527.7	10527.8	1.06	1.05
		21:00	25.2	10,398		10504.1		1.02
		22:00	25.1	9,744		9872		1.31
		23:00	24.4	9,413		9250		1.73
		0:00	24.4	8,909		8652.5		2.88

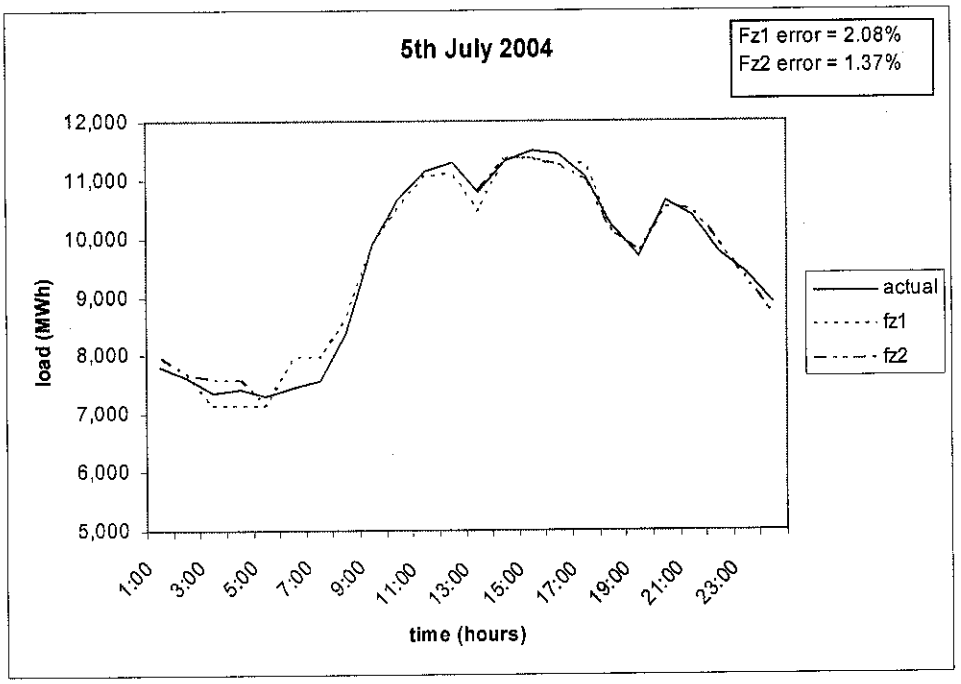


Figure 19 Comparison of Monday (5th July 2004) forecast data and actual data

Table 5 Forecast result and error calculation for Tuesday (6th July 2004)

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Tuesday	6-Jul-04	1:00	24.0	8,228		8652.5		5.16
		2:00	24.0	8,117	8165.8	7800.3	0.60	3.90
	Fz1 % err							
	2.25	3:00	24.0	7,845	7589.1	7559.9	3.26	3.63
		4:00	23.8	7,847	7137.5	7559.9	9.04	3.66
		5:00	23.7	7,717	7137.5	7137.5	7.51	7.51
	Fz2 % err							
	2.57	6:00	23.5	7,860	7939.4		1.01	
		7:00	24.5	8,041	7947.9		1.16	
		8:00	26.8	8,475	8592.6		1.39	
		9:00	27.9	9,952	9882.1		0.70	
		10:00	28.9	10,549	10519.7		0.28	
		11:00	30.3	11,180	11066.3		1.02	
		12:00	30.1	11,331	11070.2		2.30	
		13:00	30.9	10,916	10472.2	10424.8	4.07	4.50
		14:00	28.6	11,377	11344.6	11362.5	0.28	0.13
		15:00	27.8	11,409	11350.1	11362.5	0.52	0.41
		16:00	30.1	11,089	11158.2	11362.5	0.62	2.47
		17:00	30.5	10,775	11158.2	11039	3.56	2.45
		18:00	25.9	10,318	9908.7	10247.4	3.97	0.68
		19:00	25.2	9,988	9893.7	9835.7	0.94	1.52
		20:00	24.3	10,473	10524.9	10530.2	0.50	0.55
		21:00	24.3	10,249		10509		2.54
		22:00	23.7	9,719		9683.3		0.37
		23:00	23.8	9,383		9243.4		1.49
		0:00	24.0	8,845		8600		2.77

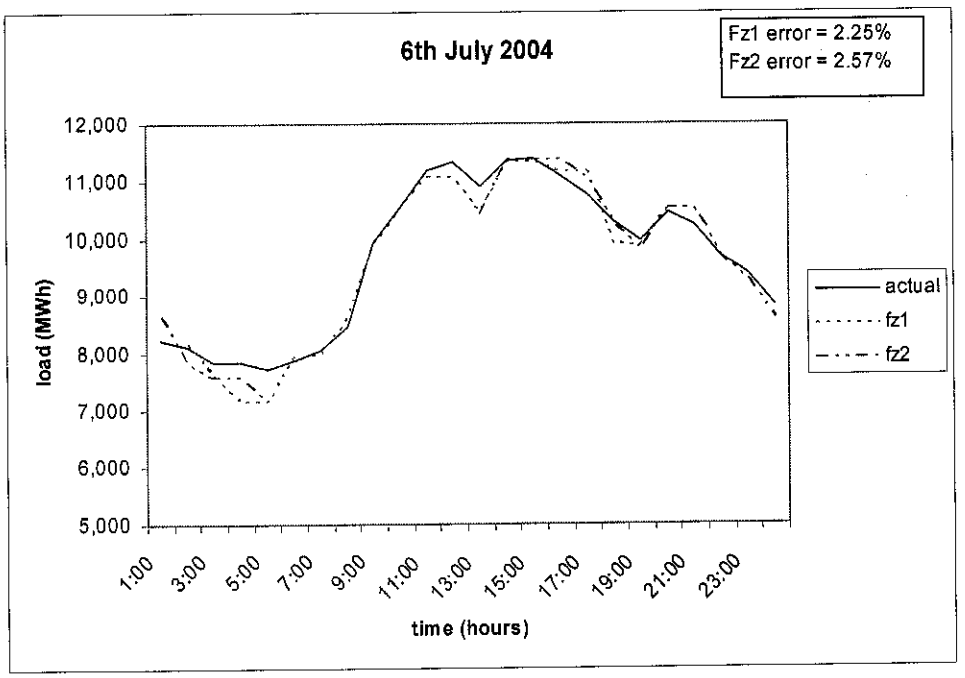


Figure 20 Comparison of Tuesday (6th July 2004) forecast data and actual data

Table 6 Forecast result and error calculation for Wednesday (7th July 2004)

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Wednesday	7-Jul-04	1:00	23.0	8,440		8600		1.90
		2:00	22.6	8,138	8465.1	7800.5	4.02	4.15
	Fz1 % err	3:00	23.0	7,990	7934.7	7559.9	0.69	5.38
	2.16	4:00	23.5	7,849	7214.6	7559.9	8.08	3.68
		5:00	23.4	7,689	7214.6	7137.5	6.17	7.17
	Fz2 % err	6:00	23.5	8,047	7939		1.34	
	2.45	7:00	23.5	8,070	7947.9		1.51	
		8:00	24.7	8,648	8592.3		0.64	
		9:00	26.0	9,977	10061.7		0.85	
		10:00	28.6	10,791	10518.5		2.53	
		11:00	29.9	11,020	11065.1		0.41	
		12:00	30.6	11,173	11069.1		0.93	
		13:00	31.9	10,782	10471.6	10673.5	2.88	1.01
		14:00	30.5	11,204	11343.8	11349	1.25	1.29
		15:00	30.0	11,307	11343.8	11349	0.33	0.37
		16:00	24.2	11,452	11343.8	11349	0.94	0.90
		17:00	25.0	10,888	10423.1	10425	4.27	4.25
		18:00	25.1	10,029	10107	10109.6	0.78	0.80
		19:00	25.1	9,685	9891.7	9788.9	2.13	1.07
		20:00	25.1	10,651	10523.9	10531	1.19	1.13
		21:00	24.8	10,315		10510.6		1.90
		22:00	25.2	9,906		9677.6		2.31
		23:00	24.8	9,265		9080.4		1.99
		0:00	25.0	8,937		8729.7		2.32

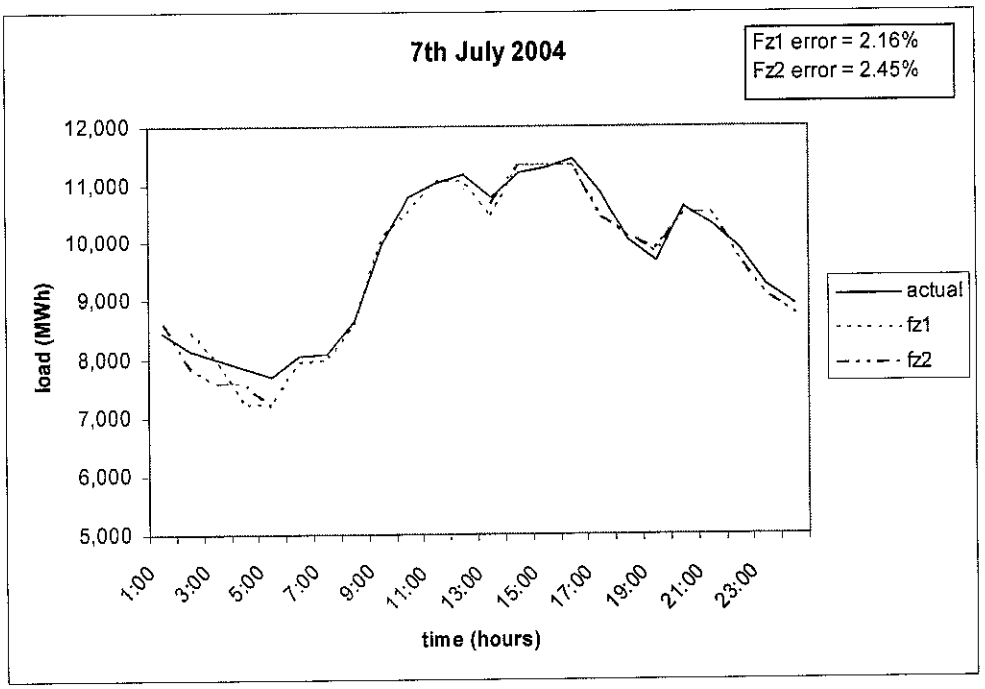


Figure 21 Comparison of Wednesday (7th July 2004) forecast data and actual data

Table 7 Forecast result and error calculation for Thursday (8th July 2004)

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Thursday	8-Jul-04	1:00	25.0	8,379		8769.1		4.66
		2:00	24.8	7,963	8011.8	8065.7	0.61	1.29
	Fz1 % err	3:00	24.7	7,925	7841.6	7649.6	1.05	3.48
	2.16	4:00	24.5	7,724	7640.4	7560	1.08	2.12
		5:00	24.3	7,763	7318.6	7257.1	5.72	6.52
	Fz2 % err	6:00	23.9	7,758	7969.7		2.73	
	2.68	7:00	23.8	8,127	7947.6		2.21	
		8:00	25.8	8,533	8591.3		0.68	
		9:00	27.7	9,891	9878.9		0.12	
		10:00	28.7	10,470	10514.4		0.42	
		11:00	29.6	10,743	11061.7		2.97	
		12:00	30.8	10,942	11066.3		1.14	
		13:00	31.2	10,507	10470.5	10446.5	0.35	0.58
		14:00	32.0	10,895	11341.3	11358.6	4.10	4.26
		15:00	32.5	10,962	11341.3	11358.6	3.46	3.62
		16:00	30.8	11,064	11341.3	11357.5	2.51	2.65
		17:00	29.3	10,633	11026.9	10863.9	3.70	2.17
		18:00	29.2	9,975	9892.6	9667.8	0.83	3.08
		19:00	28.0	9,873	9344.5	9513.4	5.35	3.64
		20:00	27.4	10,398	10188.3	10105	2.02	2.82
		21:00	26.9	10,199		10221.9		0.22
		22:00	26.2	9,715		9698.5		0.17
		23:00	25.9	9,147		9250		1.13
		0:00	25.4	8,583		8852		3.13

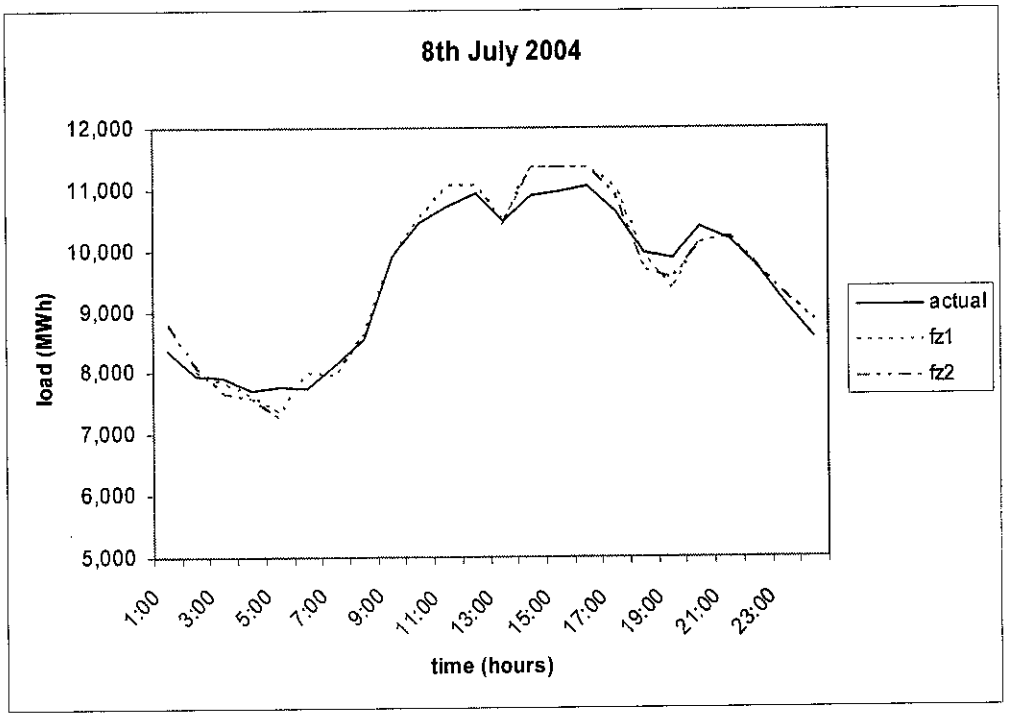


Figure 22 Comparison of Thursday (8th July 2004) forecast data and actual data

Table 8 Forecast result and error calculation for Friday (9th July 2004)

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Friday	9-Jul-04	1:00	25.3	8,271		8851.8		7.02
		2:00	25.5	8,024	7934.8	8081.8	1.11	0.72
	Fz1 % err	3:00	25.3	7,740	7841.6	7801.4	1.31	0.79
	1.49	4:00	25.3	7,608	7841.6	7801.4	3.07	2.54
		5:00	25.0	7,664	7868.7	7531.3	2.67	1.73
	Fz2 % err	6:00	24.8	7,747	7573.3		2.24	
	1.79	7:00	25.0	7,948	8089.4		1.78	
		8:00	26.9	8,441	8545.8		1.24	
		9:00	28.4	9,964	9869.5		0.95	
		10:00	28.7	10,416	10502.8		0.83	
		11:00	30.0	10,799	10981.5		1.69	
		12:00	30.2	10,915	11017.4		0.94	
		13:00	31.6	10,435	10462.4	10550	0.26	1.10
		14:00	31.4	10,544	10349.5	10225	1.84	3.03
		15:00	32.0	10,959	11091.4	11091.6	1.21	1.21
		16:00	31.0	11,114	11091.4	11362.5	0.20	2.24
		17:00	29.9	10,734	10550	10550	1.71	1.71
		18:00	29.2	10,098	9900	9900	1.96	1.96
		19:00	28.9	9,705	9491.5	9435.6	2.20	2.78
		20:00	28.4	10,375	10478.9	10497.7	1.00	1.18
		21:00	27.6	10,481		10497.7		0.16
		22:00	26.8	9,779		9880.2		1.03
		23:00	26.6	9,216		9218.3		0.02
		0:00	26.3	9,114		9223.9		1.21

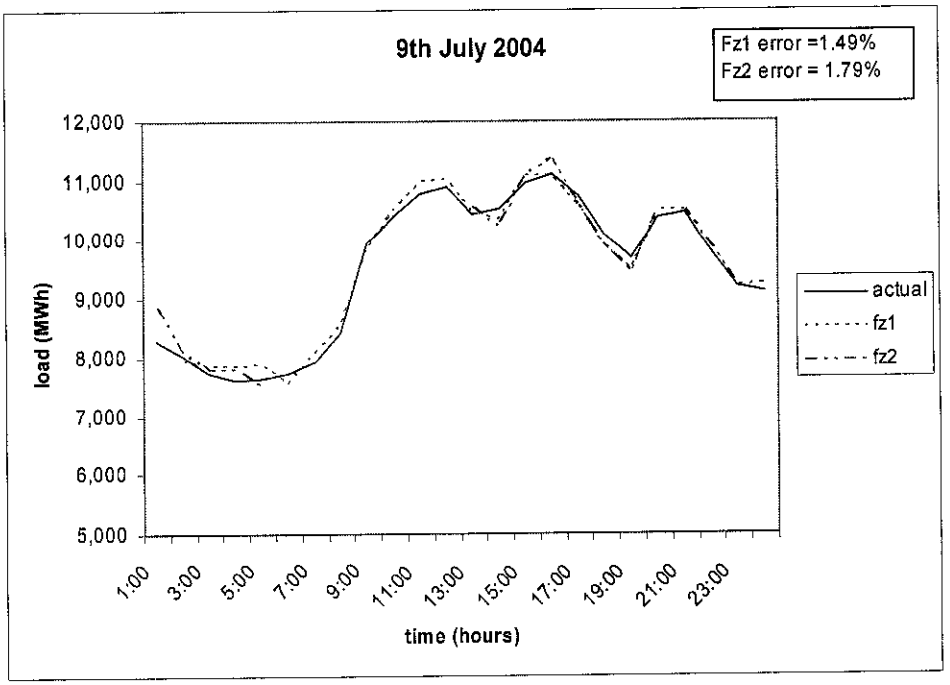


Figure 23 Comparison of Friday (9th July 2004) forecast data and actual data

Table 9 Forecast result and error calculation for Saturday (10th July 2004)

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Saturday	10-Jul-04	1:00	26.1	8,519		8600		0.95
		2:00	25.7	8,277	7983.8	8092.5	3.54	2.23
	Fz1 % err	3:00	25.1	8,144	7841.6	7841.6	3.71	3.71
	1.71	4:00	24.7	7,982	7665.7	7841.6	3.96	1.76
		5:00	24.8	7,744	7885.8	7876.2	1.83	1.71
	Fz2 % err	6:00	24.5	7,834	8036.2		2.58	
	1.75	7:00	24.9	7,870	7928		0.74	
		8:00	26.1	8,280	8148.6		1.59	
		9:00	27.5	9,293	9015.8		2.98	
		10:00	28.8	9,637	9695.2		0.60	
		11:00	25.5	10,106	10295.9		1.88	
		12:00	27.7	10,050	10136.5		0.86	
		13:00	26.3	9,590	9564.8	9436.3	0.26	1.60
		14:00	26.5	9,566	9250	9250	3.30	3.30
		15:00	26.5	9,225	9250	9250	0.27	0.27
		16:00	26.5	9,331	9250	9250	0.87	0.87
		17:00	26.9	8,775	8713.4	8713.3	0.70	0.70
		18:00	26.3	8,564	8453.4	8228.5	1.29	3.92
		19:00	25.8	8,634	8600	8600	0.39	0.39
		20:00	25.3	9,363	9250	9250	1.21	1.21
		21:00	25.0	9,406		9174.6		2.46
		22:00	24.6	9,025		9174.6		1.66
		23:00	24.1	8,634		8600		0.39
		0:00	24.2	8,236		8025.4		2.56

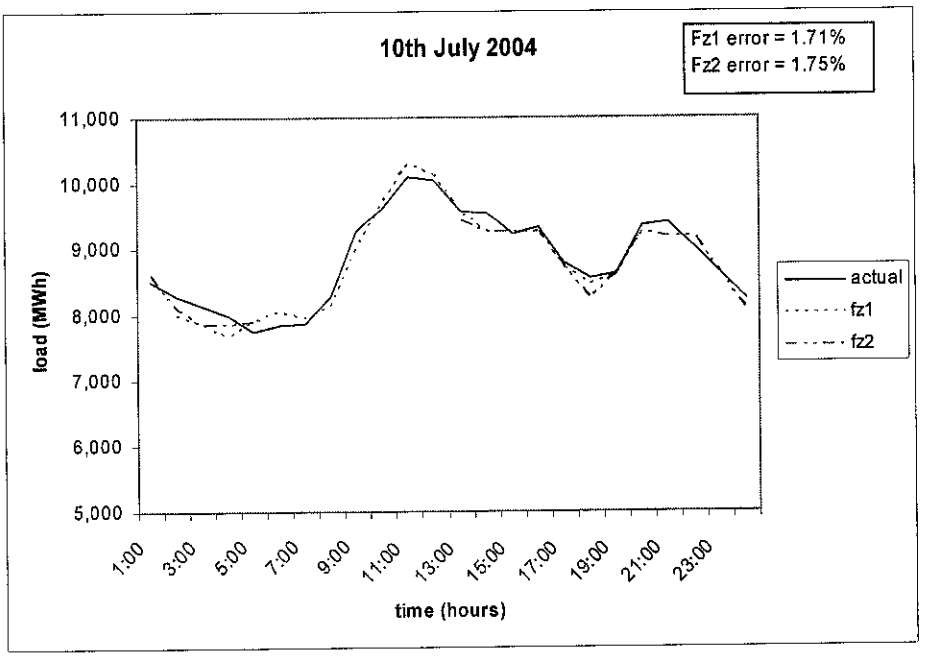


Figure 24 Comparison of Saturday (10th July 2004) forecast data and actual data

4.2 Result of 1 month ahead load forecast

As stated in chapter 3, this system uses the same model for 19 hours and 17 hours ahead load forecast system. The difference is this system use the forecasted data previously to forecast another set of data. The advantage of this system is its only use one point of actual load which is at 0100 hours on 1st July and hourly forecasted temperature data to forecast the electrical load demand for the month of July. Graph below show the output result obtained from the system.

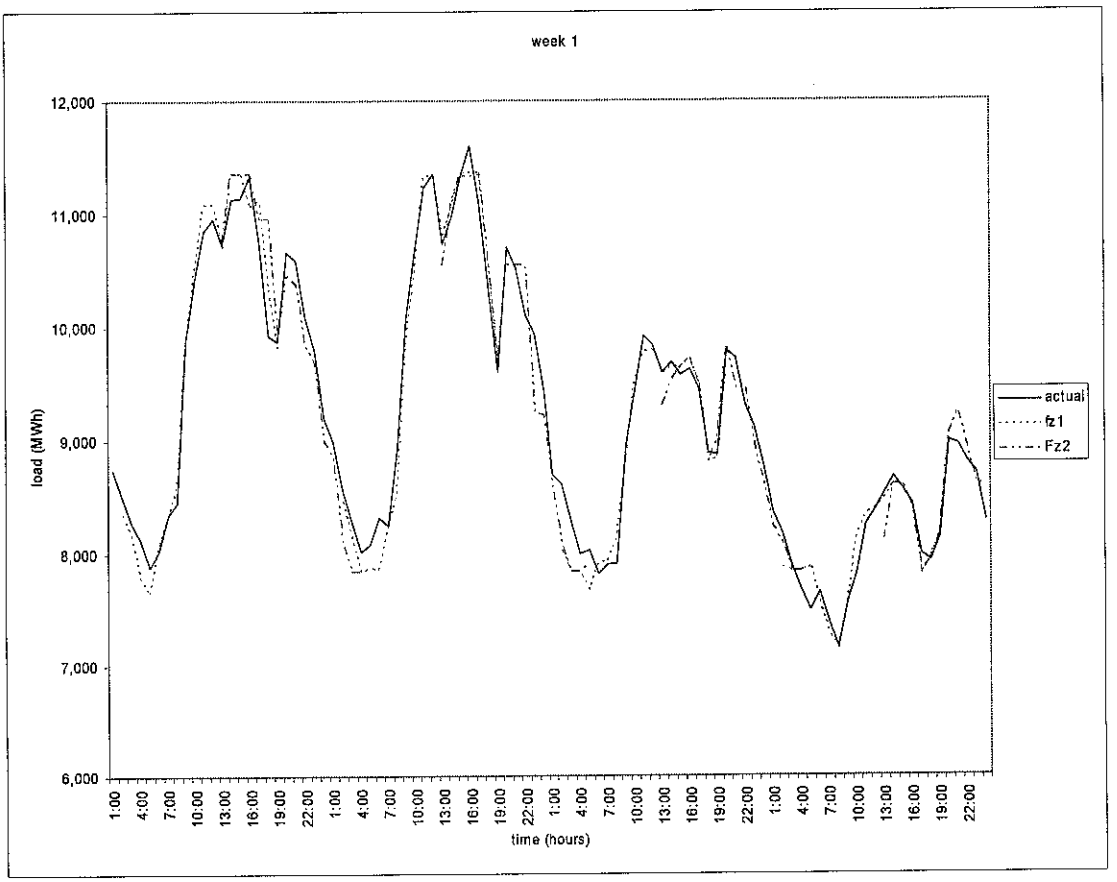


Figure 25 Result of the first week of July for 1 month ahead load forecast

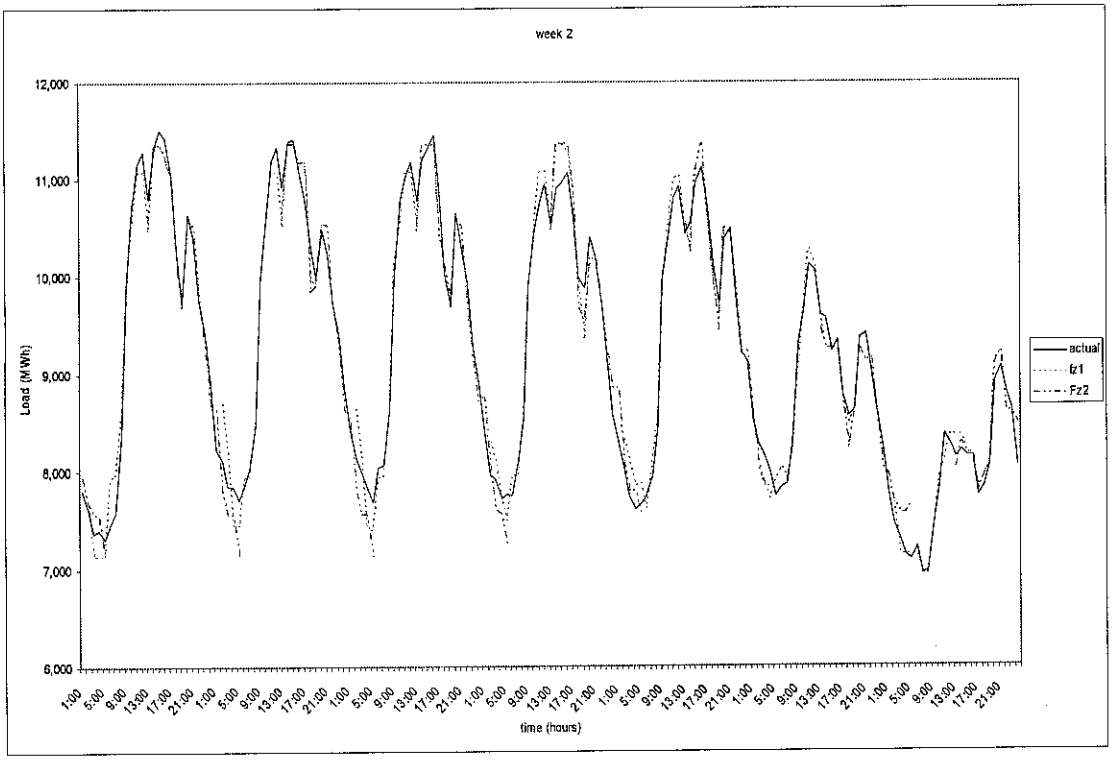


Figure 26 Result of second week of July for 1 month ahead load forecast

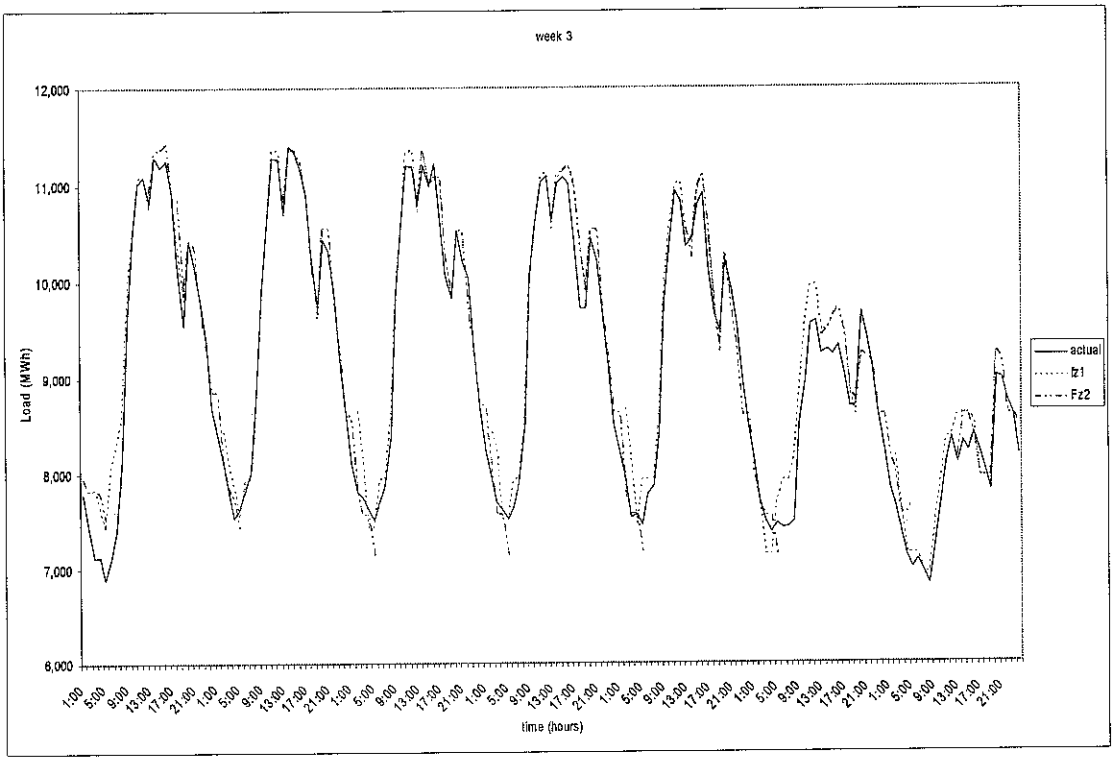


Figure 27 Result of third week of July for 1 month ahead load forecast

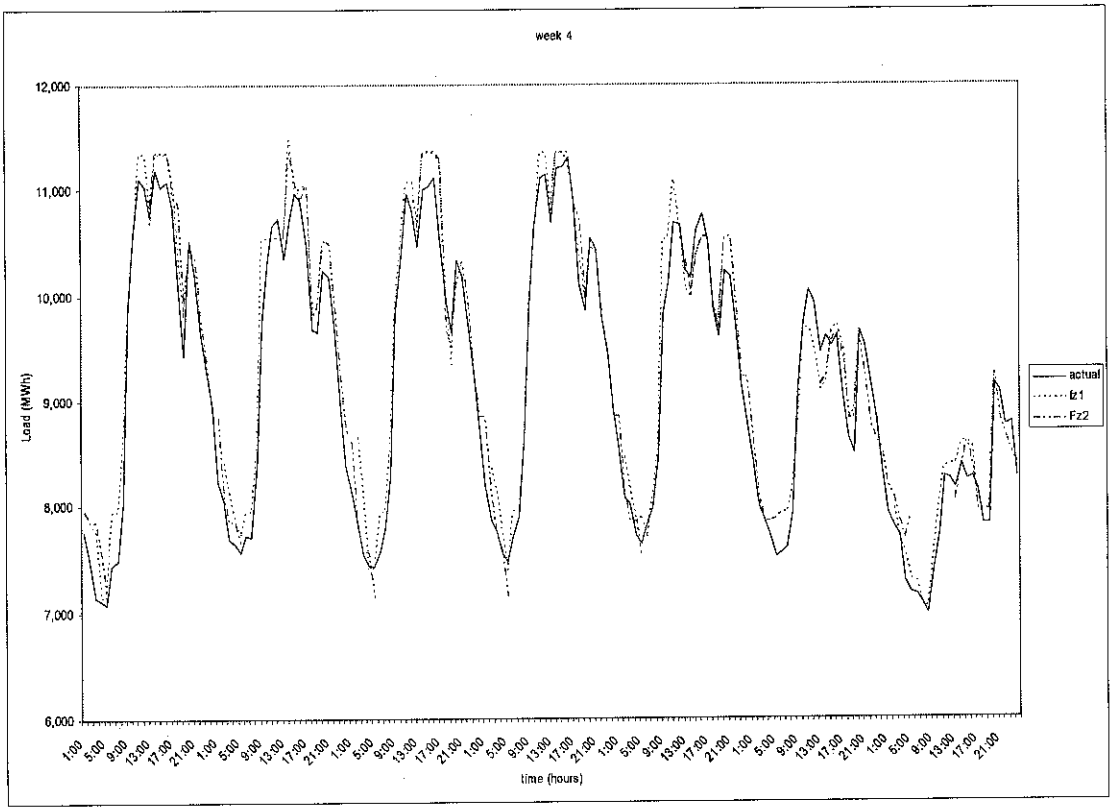


Figure 28 Result of fourth week of July for 1 month ahead load forecast

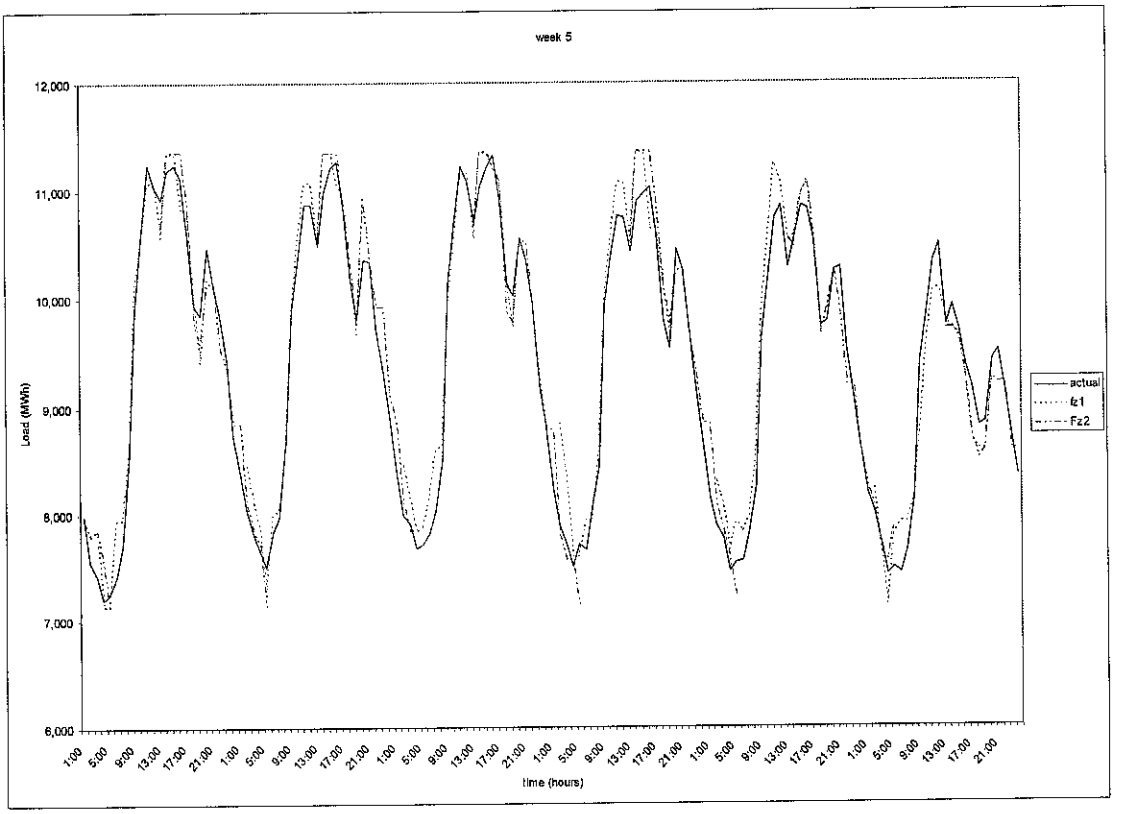


Figure 29 Result of fifth week of July for 1 month ahead load forecast

4.3 Error calculation

4.3.1 19 hours and 17 hours ahead load forecast

Below is the result summary of error calculation done on forecast result from 1st July 2004 until 31st July 2004.

Table 10 Summary of average error analysis calculation (daily) for tested forecast data from 1st July 2004 – 31st July 2004

Date	Fz1 forecast MAPE (%)	Fz2 forecast MAPE (%)
1-Jul-04	1.77	2.27
2-Jul-04	1.68	2.52
3-Jul-04	1.59	1.95
4-Jul-04	1.25	1.76
5-Jul-04	2.08	1.37
6-Jul-04	2.25	2.57
7-Jul-04	2.16	2.45
8-Jul-04	2.16	2.68
9-Jul-04	1.49	1.79
10-Jul-04	1.71	1.75
11-Jul-04	1.18	2.32
12-Jul-04	3.93	3.33
13-Jul-04	1.08	1.25
14-Jul-04	1.87	1.86
15-Jul-04	2.19	2.19
16-Jul-04	1.83	2.21
17-Jul-04	4.08	2.13
18-Jul-04	2.12	3.11
19-Jul-04	2.95	2.99
20-Jul-04	2.76	2.76
21-Jul-04	2.58	2.34
22-Jul-04	1.21	1.69
23-Jul-04	2.13	1.94
24-Jul-04	2.87	2.15
25-Jul-04	1.99	2.74
26-Jul-04	2.27	2.25
27-Jul-04	1.64	2.20
28-Jul-04	1.85	1.67
29-Jul-04	2.53	2.63
30-Jul-04	1.88	2.14
31-Jul-04	2.91	2.19
Average error	2.13	2.23

4.3.2 1 month ahead load forecast

Table below shows the summary of error calculation for 1 month ahead load forecast result.

Table 11 Summary of error analysis calculation for tested 1 month ahead forecast data (1st July -31st July 2004)

Date	Fz1 forecast MAPE (%)	Fz2 forecast MAPE (%)
1-Jul-04	1.77	2.22
2-Jul-04	1.71	2.52
3-Jul-04	1.75	2.00
4-Jul-04	1.33	1.76
5-Jul-04	1.98	1.45
6-Jul-04	2.17	2.62
7-Jul-04	2.07	2.47
8-Jul-04	2.16	2.70
9-Jul-04	1.83	1.82
10-Jul-04	1.63	1.77
11-Jul-04	1.17	2.32
12-Jul-04	3.86	3.33
13-Jul-04	1.27	1.32
14-Jul-04	2.08	1.84
15-Jul-04	2.16	2.20
16-Jul-04	2.46	2.21
17-Jul-04	4.04	2.38
18-Jul-04	2.49	3.11
19-Jul-04	2.96	2.95
20-Jul-04	3.07	2.74
21-Jul-04	3.00	2.39
22-Jul-04	1.69	1.77
23-Jul-04	2.30	1.93
24-Jul-04	2.86	2.47
25-Jul-04	2.06	2.72
26-Jul-04	2.26	2.25
27-Jul-04	2.03	2.13
28-Jul-04	2.23	1.63
29-Jul-04	2.92	2.57
30-Jul-04	2.44	2.14
31-Jul-04	2.91	2.13
Average error	2.28	2.25

4.3.3 Intercept error

In order to justify a better system to be followed while intercept condition happen, analysis on error generated by both system is done. Below is the summary of result obtained from the analysis.

Table 12 Summary of intercept error between Fz1 and Fz2 for 1st July 2004 until 20th July 2004

Date	Intercept time	Fz1 error (%)	Fz2 error (%)
1-Jul-04	1300 - 2000	1.92	2.40
2-Jul-04	0100 – 0500	1.96	3.91
	1300 - 2000	1.24	1.48
3-Jul-04	0100 – 0500	3.66	3.73
	1300 – 2000	0.73	1.12
4-Jul-04	0100 – 0500	2.70	2.19
	1300 – 2000	0.73	1.28
5-Jul-04	0100 – 0500	2.46	1.88
	1300 – 2000	1.43	0.87
6-Jul-04	0100 – 0500	5.10	4.68
	1300 – 2000	1.81	1.59
7-Jul-04	0100 – 0500	4.74	5.10
	1300 – 2000	1.72	1.35
8-Jul-04	0100 – 0500	2.12	3.35
	1300 – 2000	2.79	2.85
9-Jul-04	0100 – 0500	2.04	1.45
	1300 – 2000	1.30	1.90
10-Jul-04	0100 – 0500	3.26	2.35
	1300 – 2000	1.04	1.53
11-Jul-04	0100 – 0500	1.43	5.09
	1300 – 2000	1.11	0.87
12-Jul-04	0100 – 0500	7.44	8.37
	1300 – 2000	1.28	1.92
13-Jul-04	0100 – 0500	1.92	1.42
	1300 – 2000	0.73	0.61
14-Jul-04	0100 – 0500	4.49	2.18
	1300 – 2000	0.96	1.25
15-Jul-04	0100 – 0500	3.33	2.15
	1300 – 2000	2.49	2.15
16-Jul-04	0100 – 0500	3.54	1.68
	1300 – 2000	1.45	1.82
17-Jul-04	0100 – 0500	2.73	1.86
	1300 – 2000	3.20	2.52
18-Jul-04	0100 – 0500	1.52	5.80
	1300 – 2000	2.91	2.23
19-Jul-04	0100 – 0500	3.65	5.41
	1300 – 2000	1.96	2.77
20-Jul-04	0100 – 0500	2.25	1.72
	1300 – 2000	2.82	2.54

Table 13 Summary of intercept error between Fz1 and Fz2 for 21st July 2004 until 31st July 2004

Date	Intercept time	Fz1 error (%)	Fz2 error (%)
21-Jul-04	0100 – 0500	2.91	1.56
	1300 – 2000	2.63	2.85
22-Jul-04	0100 – 0500	1.61	1.91
	1300 – 2000	0.86	1.47
23-Jul-04	0100 – 0500	1.98	1.52
	1300 – 2000	1.56	1.47
24-Jul-04	0100 – 0500	1.81	1.93
	1300 – 2000	2.82	1.81
25-Jul-04	0100 – 0500	1.60	5.10
	1300 – 2000	2.44	1.79
26-Jul-04	0100 – 0500	2.88	3.92
	1300 – 2000	2.05	2.10
27-Jul-04	0100 – 0500	1.82	1.76
	1300 – 2000	1.83	1.74
28-Jul-04	0100 – 0500	1.42	1.57
	1300 – 2000	1.45	1.67
29-Jul-04	0100 – 0500	4.37	2.82
	1300 – 2000	2.04	2.86
30-Jul-04	0100 – 0500	1.61	2.27
	1300 – 2000	0.97	1.10
31-Jul-04	0100 – 0500	2.99	2.15
	1300 – 2000	2.14	2.44

From the calculation done, an analysis is performed based on the data obtained. Table below shows the analysis result.

Table 14 Summary of analysis done on average error calculation for intercept part of forecast data

Time range	Fz1 (%)	Fz2 (%)
0100 – 0500	2.82	3.01
1300 – 2000	1.75	1.80
Total average error	2.29	2.41

From the analysis done, seen that Fz1 system capable to produce a forecast data which has less error than Fz2 system. In this case, result of Fz1 is taken to have more priority on any intercept forecasted data generated.

CHAPTER 5
CONCLUSION

Generation of electrical energy consumed very high cost especially those that using unrenewable source as their raw material. Short term load forecast is a vital task in electrical generation industry in order reduces the wastage of electrical energy while distributed. As the price of the raw material increase, optimizing the usage of the source also might increase they profit in the industry.

Fuzzy logic technique is used in this load forecasting task because its capability to deal with non-linear system. The system is capable to perform possibility theory in order to measure uncertainty or ambiguity for the randomness measurement using fuzzy sets of linguistic rules in form of IF-THEN rules. This is because fuzzy logic is kind of intelligent system that has capability to think without any requirement of a precise input.

By having this project performed, the short term electrical load demand basically can be forecasted by using fuzzy logic technique which implemented in *fuzzytech* software. With basic design of 1 hour ahead load forecast system, the fuzzy model is expended to forecast in longer period which is 19 hours and 17 hours ahead load forecast system. This is done in order to ensure the system or model that designed is capable to be used in practical world. Apart of that, the system also is capable to forecast the electrical load demand in time range of 1 month ahead.

However due to limitation of historical data, the system only capable to reach about 97% to 98% average accuracy of the forecast data compared with the actual. This result is fulfilled the TNB requirement which is below 4% error. Some difficulties occurred in forecasting the electrical load demand when there is an abnormality happened in the energy trending. There is certain time where the relation between temperature and electrical load demand is not the same as usual. In this case, fuzzy logic system is not able to forecast the load demand accurately. Lower accuracy detected on forecast data for Saturday and Sunday. This is because the fine tuning task that performed on these two days is limited if compared with fine tuning for day of Monday to Thursday. This is also due to limitation of historical data that gathered for load profile analysis task to be performed. As additional, this system using previous forecast data in order to predict the load demand for the next hour. Due to this idea of designation, the error is cumulated to the next forecast data which might increase every time being forecasted.

Apart of that, load demand in Saturday also varies from week to week. This is because some of the state have their holiday on Saturday and the others not. Besides there also an alternate holiday on Saturday. Other than that, some holiday that fall on Sunday or others public holiday will also replaced on Saturday. However will little research and analysis on the special event in Malaysia, the accuracy of load forecasting system on Saturday is increased.

However with some effort that given on this project, the system is capable to forecast the electrical load demand in 19 hours ahead (0200 to 2000) for part 1 and 17 hours ahead (1300 to 0400 on the next day) for part 2 of the system with average error less than 3%. Apart of that, the system also capable to forecast electrical load demand for 1 month ahead with average error also less than 3%.

CHAPTER 6
RECOMMENDATIONS

Load forecasting is a vital task that should be performed by every electrical generation industry. It is recommended to all electrical generation company to have the latest and most accurate system for load forecasting to optimize their profit.

Fuzzy logic is one of the latest intelligent systems that available in the market nowadays. Fuzzy logic known as a controller that might perform better than the other intelligent system especially when dealing with non linear system and there is heuristic knowledge from human operators. It is recommended to use fuzzy logic controller into various application in the system nowadays.

After doing this project, some weakness of the system detected. The system only capable to process limited number of variable. Based on the task perform, it only capable to process below 59 variables (including input, output variables and fuzzy rule block) for one model. Initially, the designation of the system is planned to be able to forecast electrical load demand in 24 hours ahead. However due to the limitation, the model need to be split into 2 parts which are 19 hours ahead (0200 to 2000) and 17 hours ahead (1300 to 0400 on the next day). It is quite an advantage for the fuzzy system if it capable to process larger number of variable in one model.

Apart of that, load profile analysis is also recommended to be performed in longer period. By having longer period of data, it may help in designing the fuzzy rules which will be used in order to forecast the electrical load demand. With more facts and information gathered, it will improve the accuracy of the forecast result.

Tuning of the fuzzy system is one of the main tasks that should be performed while designing fuzzy system. The designed model should be tuned several times until an optimal result is obtained. These optimum results data should have an average error less than or equal to 5%. The fuzzy rules should be redefined several times to increase the system accuracy. Instead of redefining, the rules might be added manually to achieve the objective. Apart of that, adjusting degree of support (DoS) is one way of tuning the fuzzy model.

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APPENDICES

APPENDIX A: Fuzzy rules – Fz1 (19 hours ahead)

APPENDIX B: Fuzzy rules – Fz2 (17 hours ahead)

APPENDIX B: Result of forecast data (19 and 17 hours ahead load forecast)

APPENDIX C: Result of forecast of forecast data (1 month ahead load forecast)

APPENDIX D: Gantt chart

APPENDIX A

FUZZY RULES – FZ1 (19 HOURS AHEAD LOAD FORECAST)

Spreadsheet Rule Editor - RB1

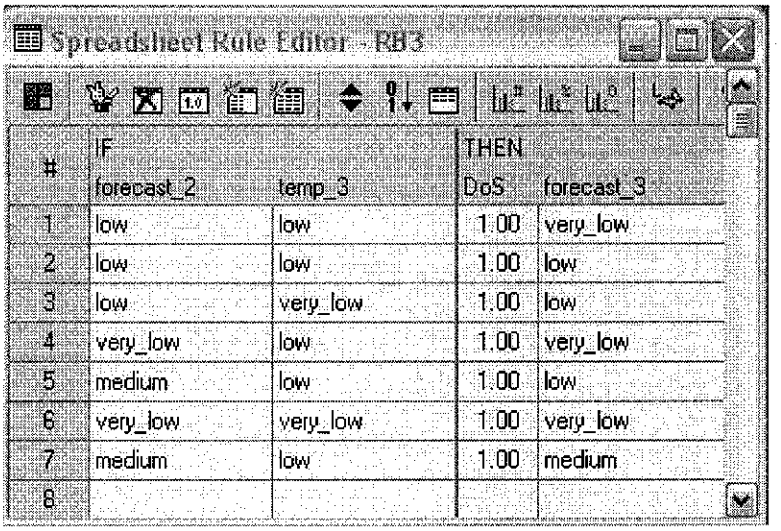
#	IF		THEN	
	load	temp_1	DoS	forecast_1
1	low	low	1.00	medium
2	medium	low	0.50	low
3	medium	low	1.00	medium
4	medium	very_low	1.00	medium
5	very_low	low	1.00	very_low
6	medium	medium	1.00	low
7	very_low	low	1.00	low
8	low	low	1.00	very_low
9	low	very_low	0.50	low
10	low	very_low	0.10	very_low
11	medium	medium	1.00	medium
12	medium	low	0.20	high
13				

Rule block number 1 Fz1 (forecast result for 0200 hours)

Spreadsheet Rule Editor - RB2

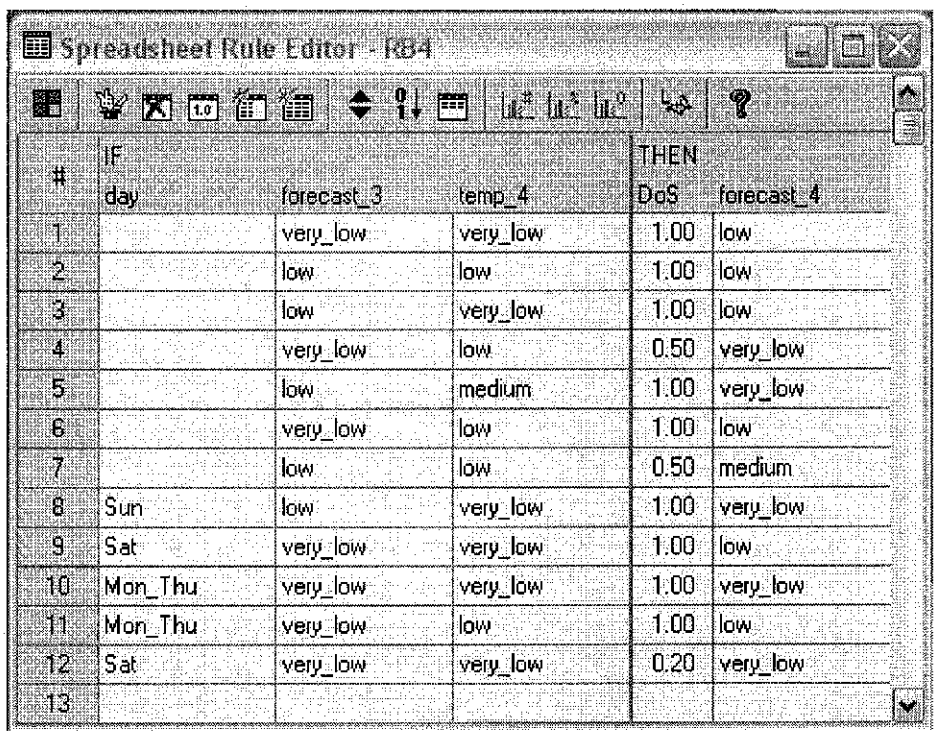
#	IF		THEN	
	forecast_1	temp_2	DoS	forecast_2
1	low	low	1.00	low
2	medium	low	1.00	low
3	very_low	low	1.00	very_low
4	medium	medium	1.00	low
5	low	very_low	1.00	low
6	low	low	1.00	very_low
7	medium	low	1.00	medium
8	medium	medium	1.00	medium
9	medium	very_low	1.00	low
10	medium	very_low	1.00	medium
11	low	very_low	1.00	very_low
12	very_low	very_low	1.00	very_low
13				

Rule block number 2 Fz1 (forecast result for 0300 hours)



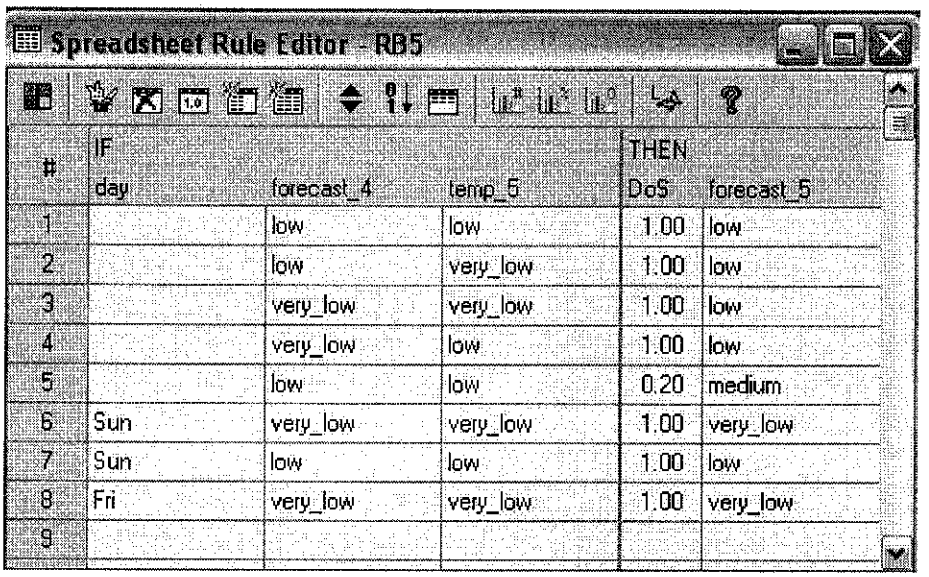
#	IF forecast_2	temp_3	THEN DoS	forecast_3
1	low	low	1.00	very_low
2	low	low	1.00	low
3	low	very_low	1.00	low
4	very_low	low	1.00	very_low
5	medium	low	1.00	low
6	very_low	very_low	1.00	very_low
7	medium	low	1.00	medium
8				

Rule block number 3 Fz1 (forecast result for 0400 hours)



#	IF day	forecast_3	temp_4	THEN DoS	forecast_4
1		very_low	very_low	1.00	low
2		low	low	1.00	low
3		low	very_low	1.00	low
4		very_low	low	0.50	very_low
5		low	medium	1.00	very_low
6		very_low	low	1.00	low
7		low	low	0.50	medium
8	Sun	low	very_low	1.00	very_low
9	Sat	very_low	very_low	1.00	low
10	Mon_Thu	very_low	very_low	1.00	very_low
11	Mon_Thu	very_low	low	1.00	low
12	Sat	very_low	very_low	0.20	very_low
13					

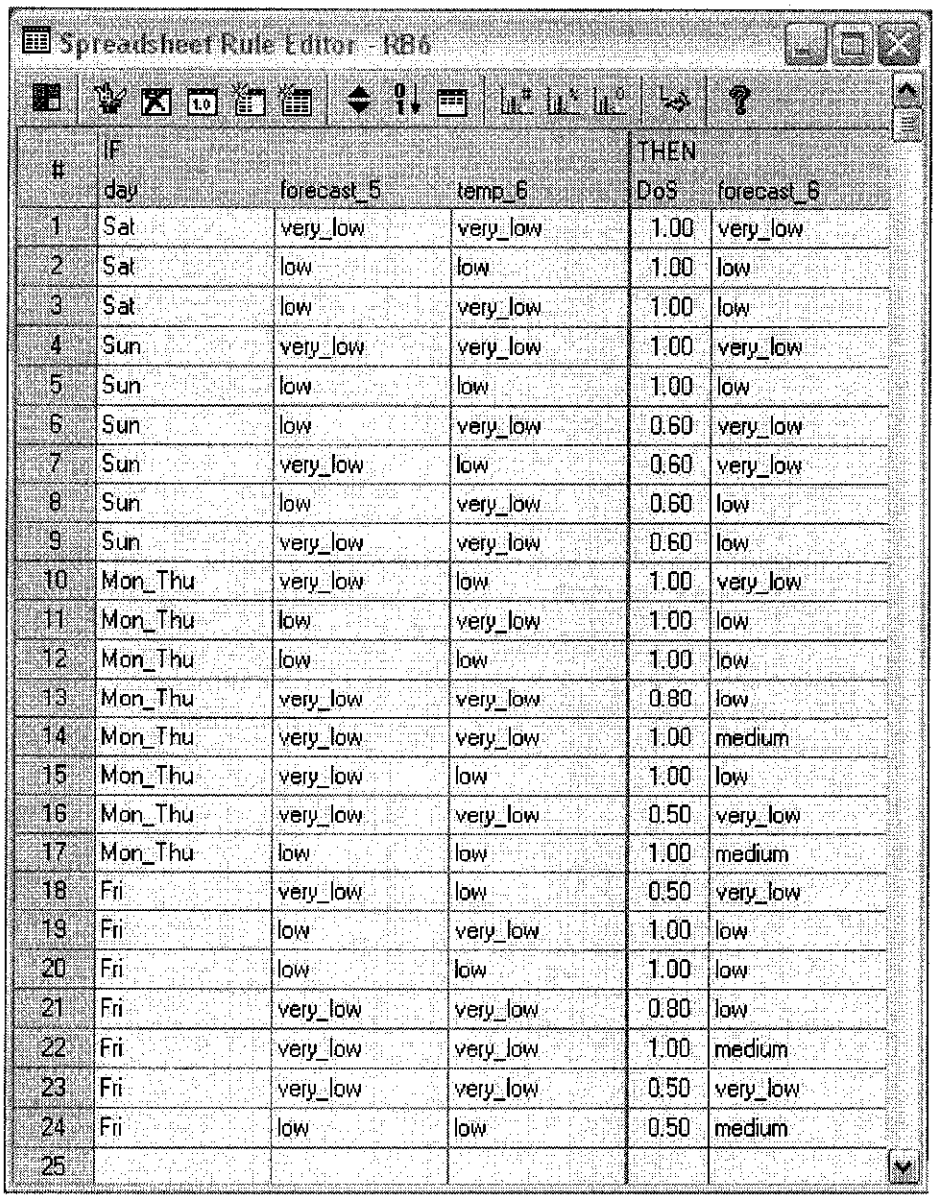
Rule block number 4 Fz1 (forecast result for 0500 hours)



Spreadsheet Rule Editor - RB5

#	IF day	forecast_4	temp_5	THEN DoS	forecast_5
1		low	low	1.00	low
2		low	very_low	1.00	low
3		very_low	very_low	1.00	low
4		very_low	low	1.00	low
5		low	low	0.20	medium
6	Sun	very_low	very_low	1.00	very_low
7	Sun	low	low	1.00	low
8	Fri	very_low	very_low	1.00	very_low
9					

Rule block number 5 Fz1 (forecast result for 0600 hours)



Spreadsheet Rule Editor - RB6

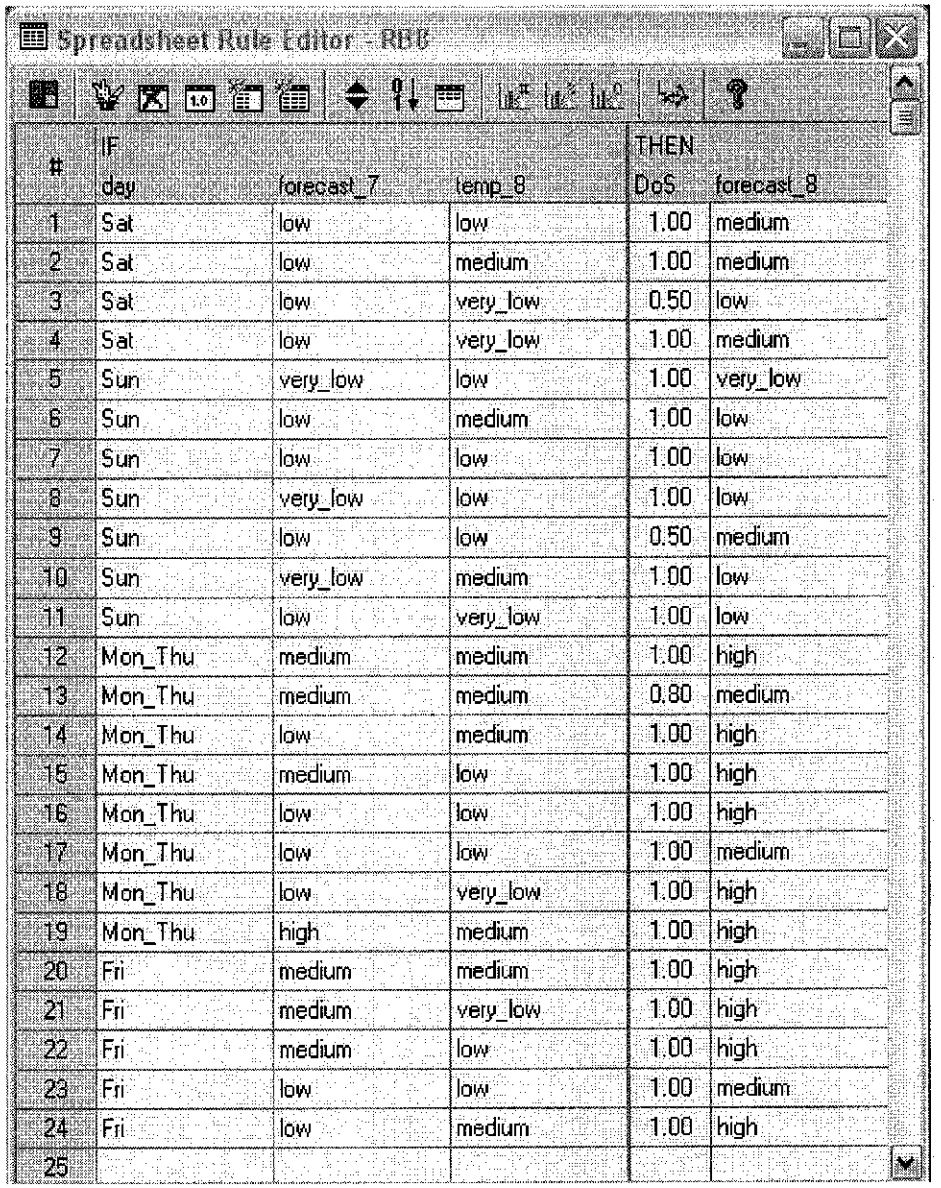
#	IF day	forecast_5	temp_6	THEN DoS	forecast_6
1	Sat	very_low	very_low	1.00	very_low
2	Sat	low	low	1.00	low
3	Sat	low	very_low	1.00	low
4	Sun	very_low	very_low	1.00	very_low
5	Sun	low	low	1.00	low
6	Sun	low	very_low	0.60	very_low
7	Sun	very_low	low	0.60	very_low
8	Sun	low	very_low	0.60	low
9	Sun	very_low	very_low	0.60	low
10	Mon_Thu	very_low	low	1.00	very_low
11	Mon_Thu	low	very_low	1.00	low
12	Mon_Thu	low	low	1.00	low
13	Mon_Thu	very_low	very_low	0.80	low
14	Mon_Thu	very_low	very_low	1.00	medium
15	Mon_Thu	very_low	low	1.00	low
16	Mon_Thu	very_low	very_low	0.50	very_low
17	Mon_Thu	low	low	1.00	medium
18	Fri	very_low	low	0.50	very_low
19	Fri	low	very_low	1.00	low
20	Fri	low	low	1.00	low
21	Fri	very_low	very_low	0.80	low
22	Fri	very_low	very_low	1.00	medium
23	Fri	very_low	very_low	0.50	very_low
24	Fri	low	low	0.50	medium
25					

Rule block number 6 Fz1 (forecast result for 0700 hours)

Spreadsheet Rule Editor - RB7

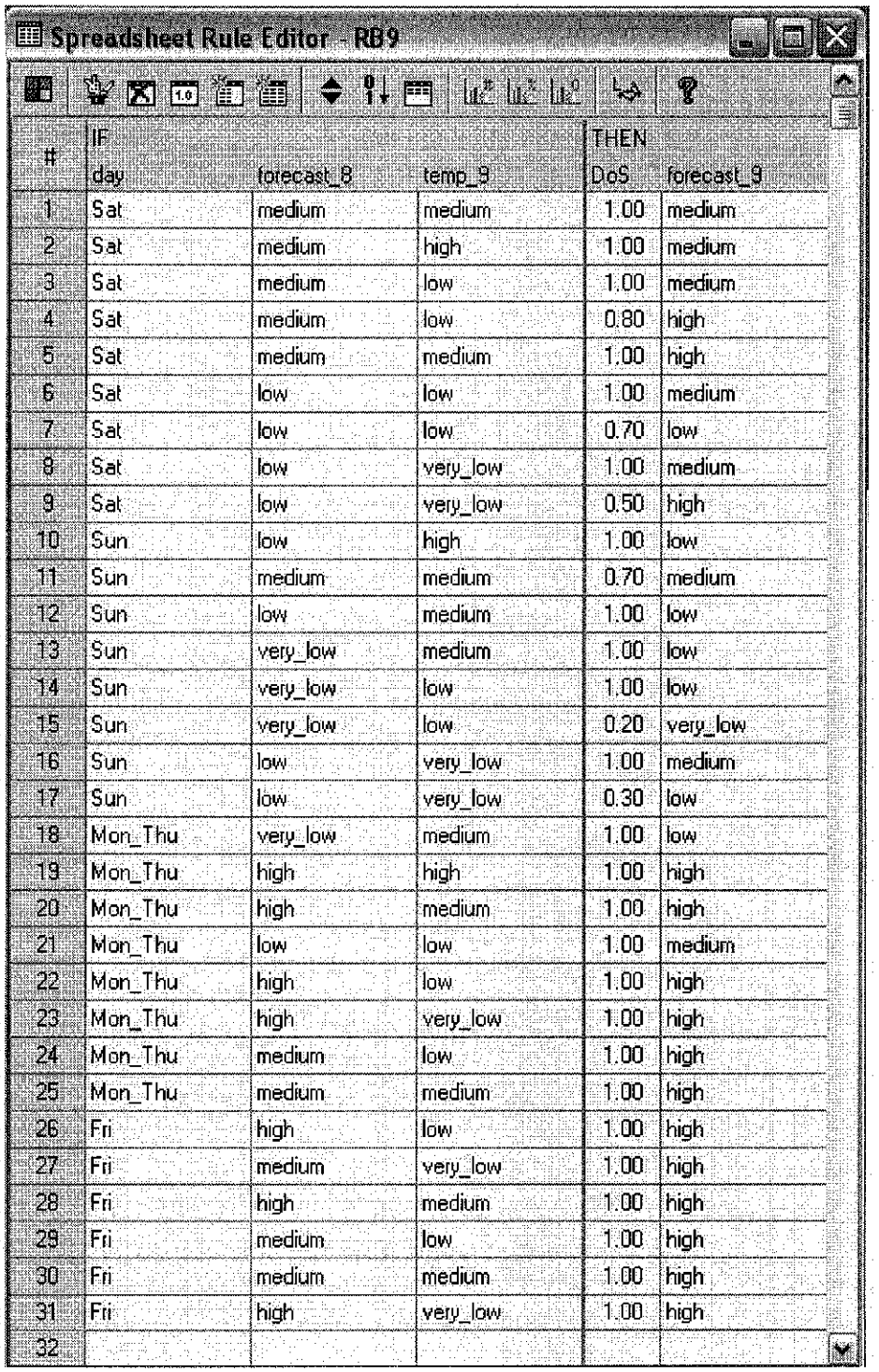
#	IF day	forecast_6	temp_7	THEN DoS	forecast_7
1	Sat	very_low	low	1.00	very_low
2	Sat	low	low	1.00	low
3	Sat	very_low	very_low	1.00	very_low
4	Sat	low	very_low	1.00	low
5	Sat	low	very_low	0.20	medium
6	Sun	very_low	low	1.00	very_low
7	Sun	low	low	1.00	low
8	Sun	low	very_low	1.00	low
9	Sun	low	very_low	1.00	very_low
10	Sun	low	low	1.00	very_low
11	Sun	very_low	very_low	1.00	very_low
12	Mon_Thu	very_low	low	0.50	very_low
13	Mon_Thu	low	low	0.80	low
14	Mon_Thu	low	very_low	1.00	low
15	Mon_Thu	low	very_low	1.00	medium
16	Mon_Thu	very_low	very_low	1.00	low
17	Mon_Thu	low	low	1.00	medium
18	Fri	low	low	1.00	medium
19	Fri	low	very_low	1.00	medium
20	Fri	low	very_low	1.00	low
21	Fri	low	low	1.00	low
22	Fri	low	very_low	0.50	high
23	Fri	low	very_low	0.50	very_low
24					

Rule block number 7 Fz1 (forecast result for 0800 hours)



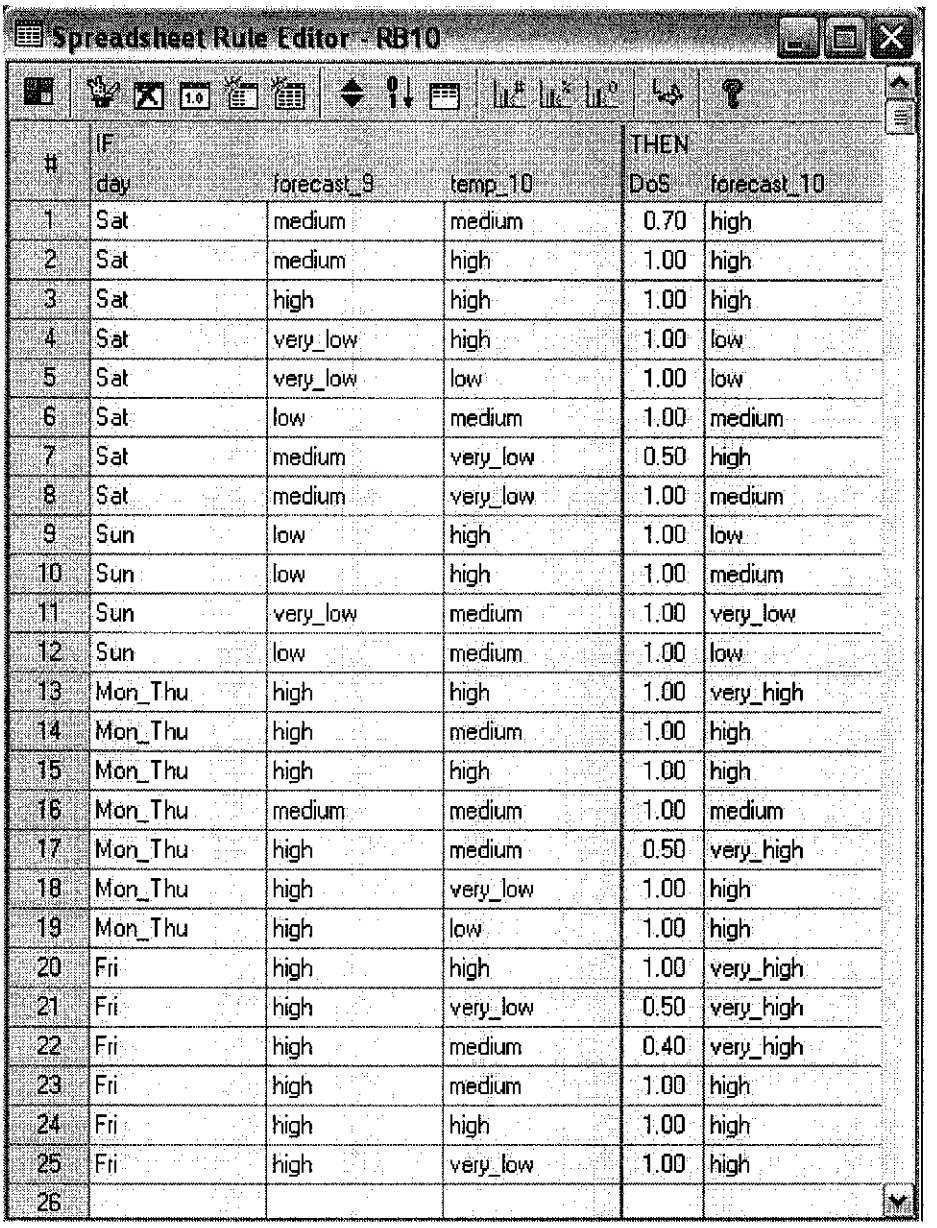
#	IF day	forecast_7	temp_8	THEN DoS	forecast_8
1	Sat	low	low	1.00	medium
2	Sat	low	medium	1.00	medium
3	Sat	low	very_low	0.50	low
4	Sat	low	very_low	1.00	medium
5	Sun	very_low	low	1.00	very_low
6	Sun	low	medium	1.00	low
7	Sun	low	low	1.00	low
8	Sun	very_low	low	1.00	low
9	Sun	low	low	0.50	medium
10	Sun	very_low	medium	1.00	low
11	Sun	low	very_low	1.00	low
12	Mon_Thu	medium	medium	1.00	high
13	Mon_Thu	medium	medium	0.80	medium
14	Mon_Thu	low	medium	1.00	high
15	Mon_Thu	medium	low	1.00	high
16	Mon_Thu	low	low	1.00	high
17	Mon_Thu	low	low	1.00	medium
18	Mon_Thu	low	very_low	1.00	high
19	Mon_Thu	high	medium	1.00	high
20	Fri	medium	medium	1.00	high
21	Fri	medium	very_low	1.00	high
22	Fri	medium	low	1.00	high
23	Fri	low	low	1.00	medium
24	Fri	low	medium	1.00	high
25					

Rule block number 8 Fz1 (forecast result for 0900 hours)



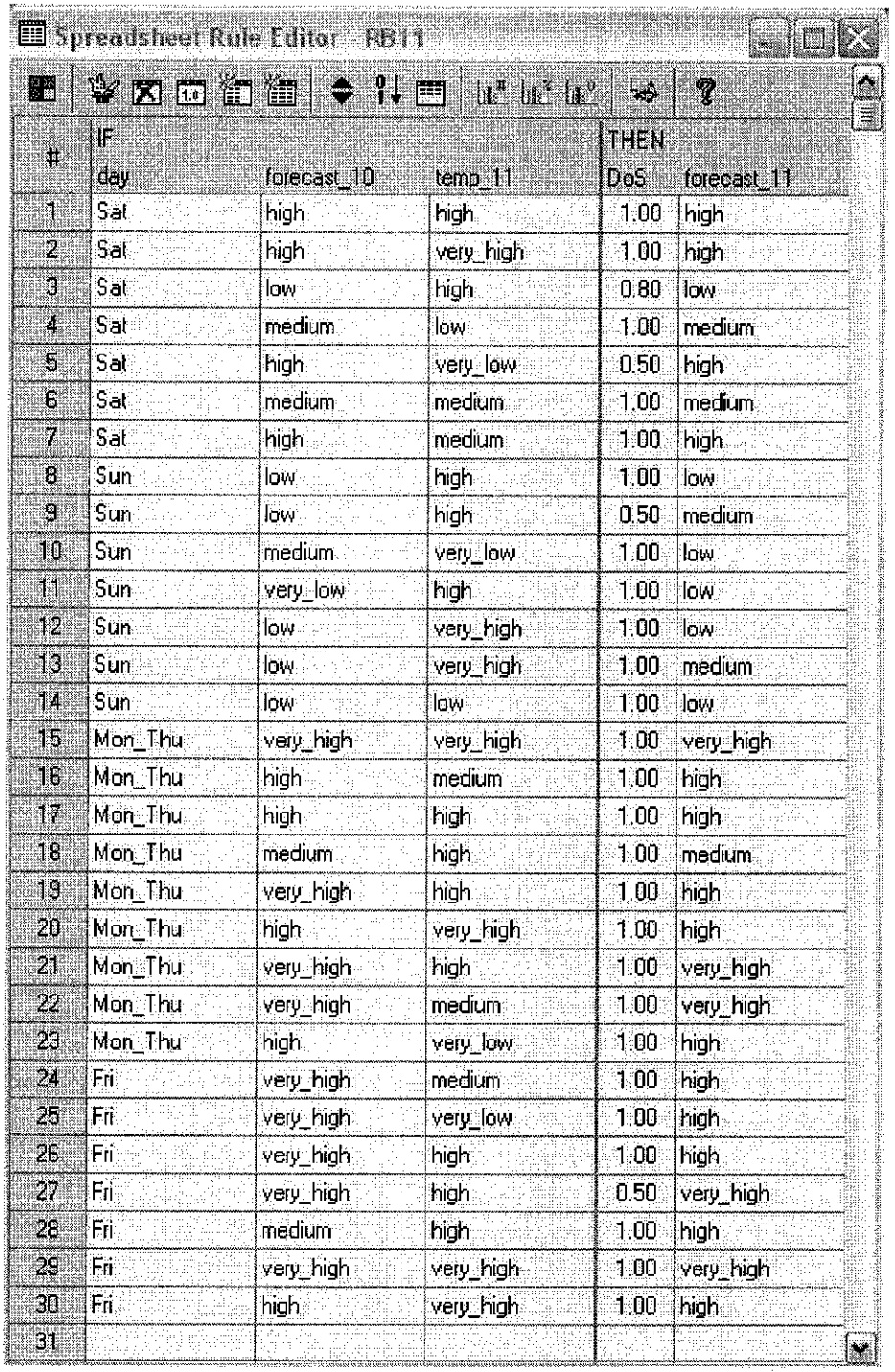
#	IF			THEN	
	day	forecast_8	temp_9	DoS	forecast_9
1	Sat	medium	medium	1.00	medium
2	Sat	medium	high	1.00	medium
3	Sat	medium	low	1.00	medium
4	Sat	medium	low	0.80	high
5	Sat	medium	medium	1.00	high
6	Sat	low	low	1.00	medium
7	Sat	low	low	0.70	low
8	Sat	low	very_low	1.00	medium
9	Sat	low	very_low	0.50	high
10	Sun	low	high	1.00	low
11	Sun	medium	medium	0.70	medium
12	Sun	low	medium	1.00	low
13	Sun	very_low	medium	1.00	low
14	Sun	very_low	low	1.00	low
15	Sun	very_low	low	0.20	very_low
16	Sun	low	very_low	1.00	medium
17	Sun	low	very_low	0.30	low
18	Mon_Thu	very_low	medium	1.00	low
19	Mon_Thu	high	high	1.00	high
20	Mon_Thu	high	medium	1.00	high
21	Mon_Thu	low	low	1.00	medium
22	Mon_Thu	high	low	1.00	high
23	Mon_Thu	high	very_low	1.00	high
24	Mon_Thu	medium	low	1.00	high
25	Mon_Thu	medium	medium	1.00	high
26	Fri	high	low	1.00	high
27	Fri	medium	very_low	1.00	high
28	Fri	high	medium	1.00	high
29	Fri	medium	low	1.00	high
30	Fri	medium	medium	1.00	high
31	Fri	high	very_low	1.00	high
32					

Rule block number 9 Fz1 (forecast result for 1000 hours)



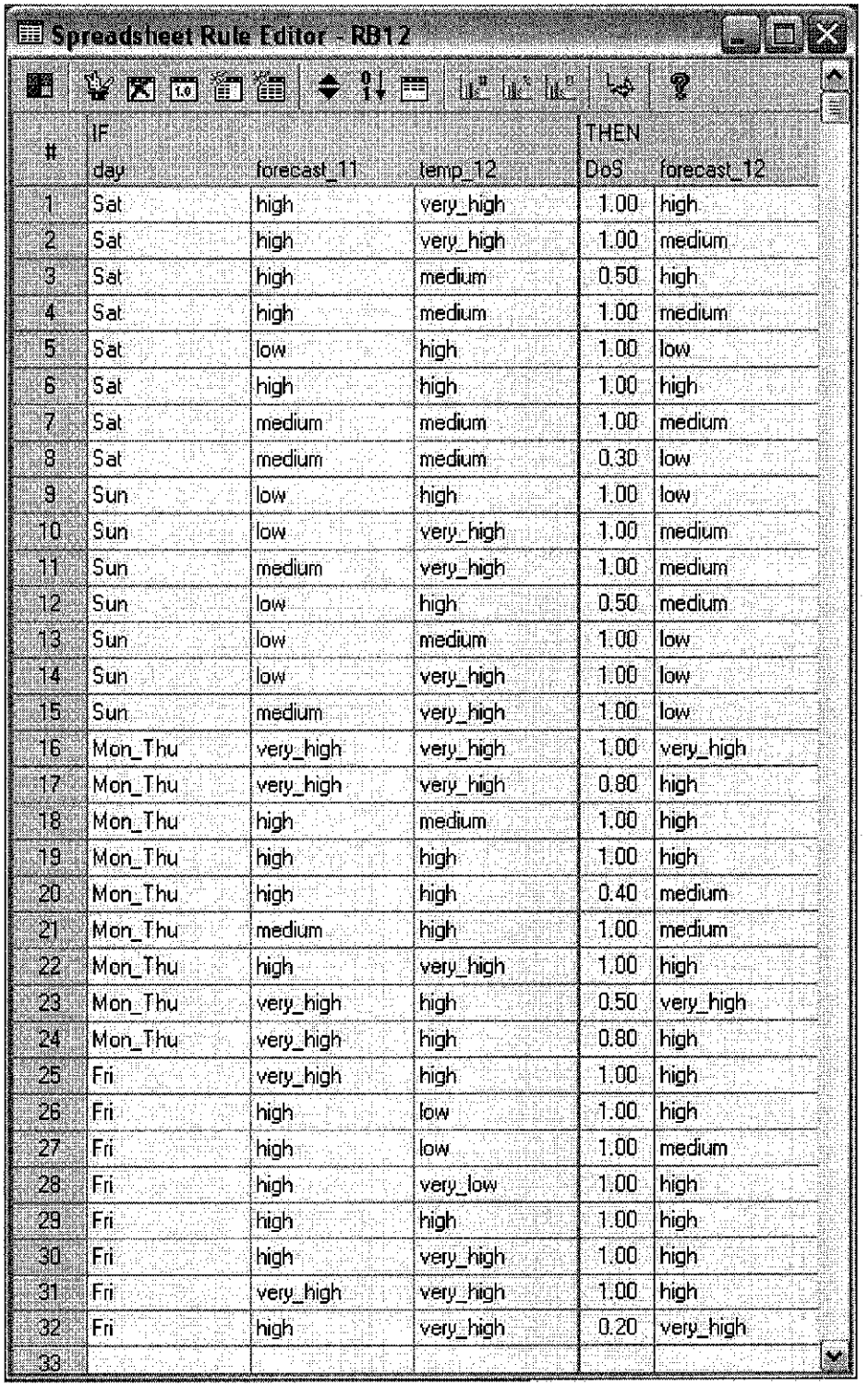
#	IF day	forecast_9	temp_10	THEN DoS	forecast_10
1	Sat	medium	medium	0.70	high
2	Sat	medium	high	1.00	high
3	Sat	high	high	1.00	high
4	Sat	very_low	high	1.00	low
5	Sat	very_low	low	1.00	low
6	Sat	low	medium	1.00	medium
7	Sat	medium	very_low	0.50	high
8	Sat	medium	very_low	1.00	medium
9	Sun	low	high	1.00	low
10	Sun	low	high	1.00	medium
11	Sun	very_low	medium	1.00	very_low
12	Sun	low	medium	1.00	low
13	Mon_Thu	high	high	1.00	very_high
14	Mon_Thu	high	medium	1.00	high
15	Mon_Thu	high	high	1.00	high
16	Mon_Thu	medium	medium	1.00	medium
17	Mon_Thu	high	medium	0.50	very_high
18	Mon_Thu	high	very_low	1.00	high
19	Mon_Thu	high	low	1.00	high
20	Fri	high	high	1.00	very_high
21	Fri	high	very_low	0.50	very_high
22	Fri	high	medium	0.40	very_high
23	Fri	high	medium	1.00	high
24	Fri	high	high	1.00	high
25	Fri	high	very_low	1.00	high
26					

Rule block number 10 Fz1 (forecast result for 1100 hours)



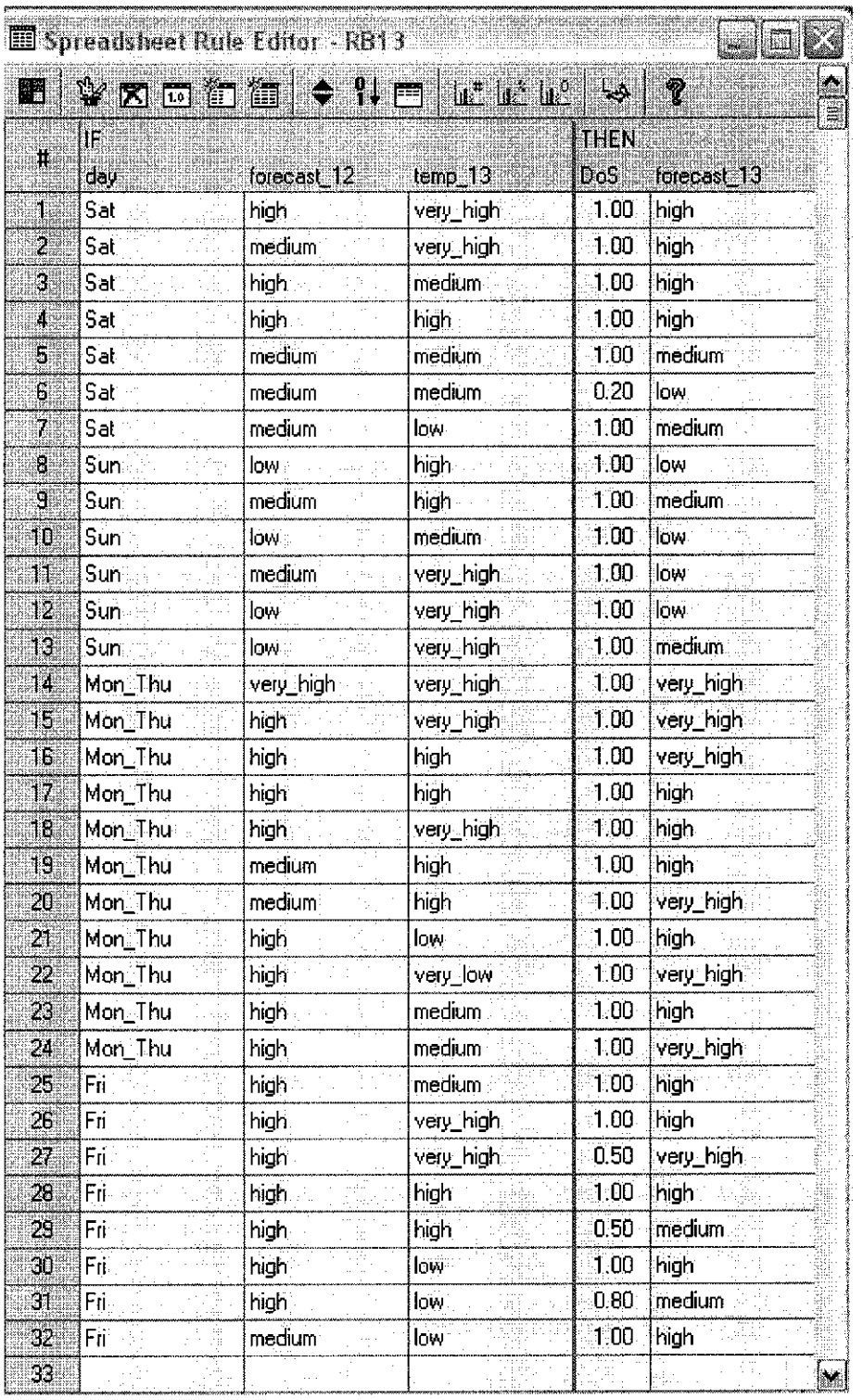
#	IF			THEN	
	day	forecast_10	temp_11	DoS	forecast_11
1	Sat	high	high	1.00	high
2	Sat	high	very_high	1.00	high
3	Sat	low	high	0.80	low
4	Sat	medium	low	1.00	medium
5	Sat	high	very_low	0.50	high
6	Sat	medium	medium	1.00	medium
7	Sat	high	medium	1.00	high
8	Sun	low	high	1.00	low
9	Sun	low	high	0.50	medium
10	Sun	medium	very_low	1.00	low
11	Sun	very_low	high	1.00	low
12	Sun	low	very_high	1.00	low
13	Sun	low	very_high	1.00	medium
14	Sun	low	low	1.00	low
15	Mon_Thu	very_high	very_high	1.00	very_high
16	Mon_Thu	high	medium	1.00	high
17	Mon_Thu	high	high	1.00	high
18	Mon_Thu	medium	high	1.00	medium
19	Mon_Thu	very_high	high	1.00	high
20	Mon_Thu	high	very_high	1.00	high
21	Mon_Thu	very_high	high	1.00	very_high
22	Mon_Thu	very_high	medium	1.00	very_high
23	Mon_Thu	high	very_low	1.00	high
24	Fri	very_high	medium	1.00	high
25	Fri	very_high	very_low	1.00	high
26	Fri	very_high	high	1.00	high
27	Fri	very_high	high	0.50	very_high
28	Fri	medium	high	1.00	high
29	Fri	very_high	very_high	1.00	very_high
30	Fri	high	very_high	1.00	high
31					

Rule block number 11 Fz1 (forecast result for 1200 hours)



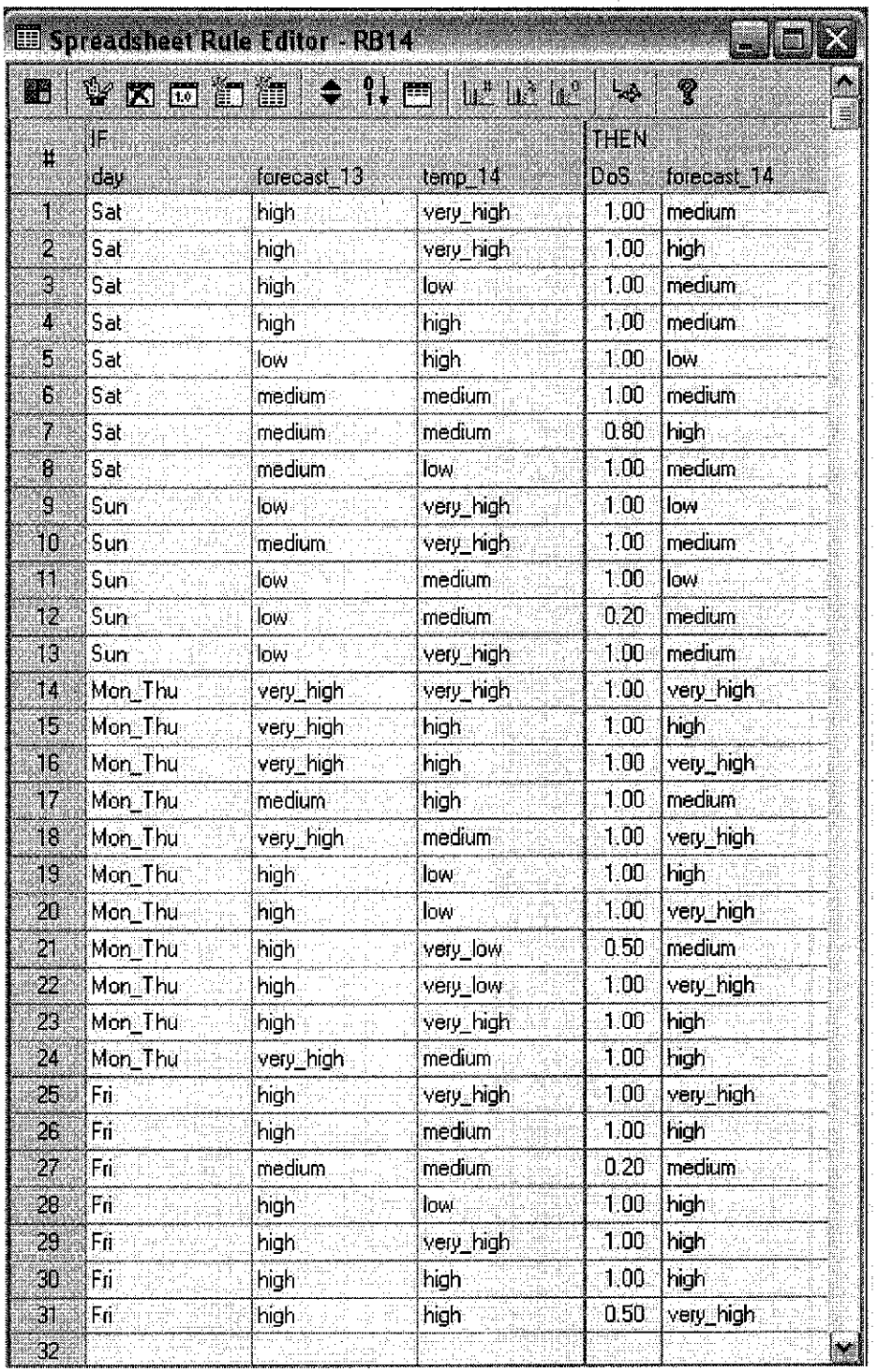
#	IF day	forecast_11	temp_12	THEN DoS	forecast_12
1	Sat	high	very_high	1.00	high
2	Sat	high	very_high	1.00	medium
3	Sat	high	medium	0.50	high
4	Sat	high	medium	1.00	medium
5	Sat	low	high	1.00	low
6	Sat	high	high	1.00	high
7	Sat	medium	medium	1.00	medium
8	Sat	medium	medium	0.30	low
9	Sun	low	high	1.00	low
10	Sun	low	very_high	1.00	medium
11	Sun	medium	very_high	1.00	medium
12	Sun	low	high	0.50	medium
13	Sun	low	medium	1.00	low
14	Sun	low	very_high	1.00	low
15	Sun	medium	very_high	1.00	low
16	Mon_Thu	very_high	very_high	1.00	very_high
17	Mon_Thu	very_high	very_high	0.80	high
18	Mon_Thu	high	medium	1.00	high
19	Mon_Thu	high	high	1.00	high
20	Mon_Thu	high	high	0.40	medium
21	Mon_Thu	medium	high	1.00	medium
22	Mon_Thu	high	very_high	1.00	high
23	Mon_Thu	very_high	high	0.50	very_high
24	Mon_Thu	very_high	high	0.80	high
25	Fri	very_high	high	1.00	high
26	Fri	high	low	1.00	high
27	Fri	high	low	1.00	medium
28	Fri	high	very_low	1.00	high
29	Fri	high	high	1.00	high
30	Fri	high	very_high	1.00	high
31	Fri	very_high	very_high	1.00	high
32	Fri	high	very_high	0.20	very_high
33					

Rule block number 12 Fz1 (forecast result for 1300 hours)



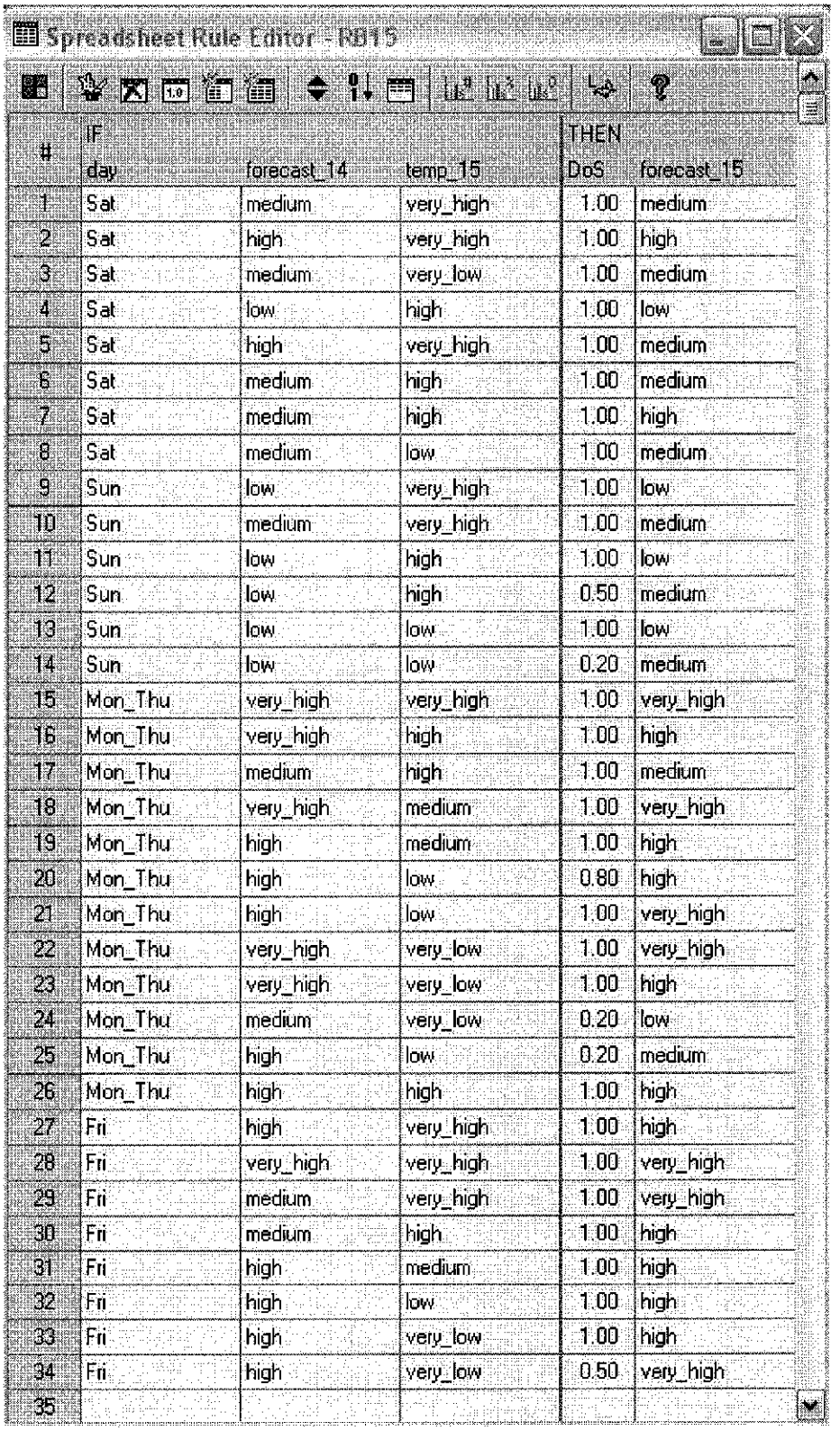
#	IF			THEN	
	day	forecast_12	temp_13	DoS	forecast_13
1	Sat	high	very_high	1.00	high
2	Sat	medium	very_high	1.00	high
3	Sat	high	medium	1.00	high
4	Sat	high	high	1.00	high
5	Sat	medium	medium	1.00	medium
6	Sat	medium	medium	0.20	low
7	Sat	medium	low	1.00	medium
8	Sun	low	high	1.00	low
9	Sun	medium	high	1.00	medium
10	Sun	low	medium	1.00	low
11	Sun	medium	very_high	1.00	low
12	Sun	low	very_high	1.00	low
13	Sun	low	very_high	1.00	medium
14	Mon_Thu	very_high	very_high	1.00	very_high
15	Mon_Thu	high	very_high	1.00	very_high
16	Mon_Thu	high	high	1.00	very_high
17	Mon_Thu	high	high	1.00	high
18	Mon_Thu	high	very_high	1.00	high
19	Mon_Thu	medium	high	1.00	high
20	Mon_Thu	medium	high	1.00	very_high
21	Mon_Thu	high	low	1.00	high
22	Mon_Thu	high	very_low	1.00	very_high
23	Mon_Thu	high	medium	1.00	high
24	Mon_Thu	high	medium	1.00	very_high
25	Fri	high	medium	1.00	high
26	Fri	high	very_high	1.00	high
27	Fri	high	very_high	0.50	very_high
28	Fri	high	high	1.00	high
29	Fri	high	high	0.50	medium
30	Fri	high	low	1.00	high
31	Fri	high	low	0.80	medium
32	Fri	medium	low	1.00	high
33					

Rule block number 13 Fz1 (forecast result for 1400 hours)



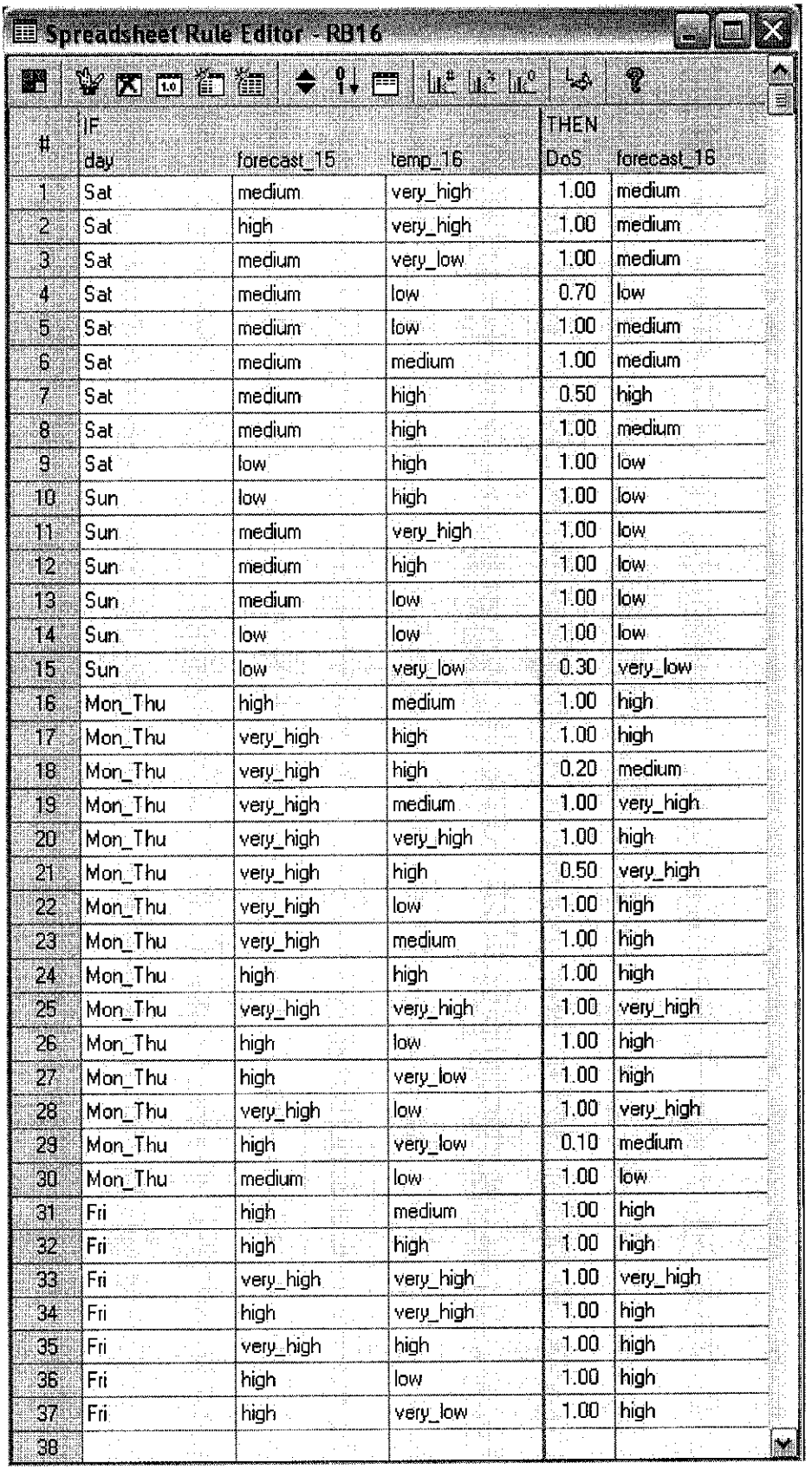
#	IF day	forecast_13	temp_14	THEN DoS	forecast_T4
1	Sat	high	very_high	1.00	medium
2	Sat	high	very_high	1.00	high
3	Sat	high	low	1.00	medium
4	Sat	high	high	1.00	medium
5	Sat	low	high	1.00	low
6	Sat	medium	medium	1.00	medium
7	Sat	medium	medium	0.80	high
8	Sat	medium	low	1.00	medium
9	Sun	low	very_high	1.00	low
10	Sun	medium	very_high	1.00	medium
11	Sun	low	medium	1.00	low
12	Sun	low	medium	0.20	medium
13	Sun	low	very_high	1.00	medium
14	Mon_Thu	very_high	very_high	1.00	very_high
15	Mon_Thu	very_high	high	1.00	high
16	Mon_Thu	very_high	high	1.00	very_high
17	Mon_Thu	medium	high	1.00	medium
18	Mon_Thu	very_high	medium	1.00	very_high
19	Mon_Thu	high	low	1.00	high
20	Mon_Thu	high	low	1.00	very_high
21	Mon_Thu	high	very_low	0.50	medium
22	Mon_Thu	high	very_low	1.00	very_high
23	Mon_Thu	high	very_high	1.00	high
24	Mon_Thu	very_high	medium	1.00	high
25	Fri	high	very_high	1.00	very_high
26	Fri	high	medium	1.00	high
27	Fri	medium	medium	0.20	medium
28	Fri	high	low	1.00	high
29	Fri	high	very_high	1.00	high
30	Fri	high	high	1.00	high
31	Fri	high	high	0.50	very_high
32					

Rule block number 14 Fz1 (forecast result for 1500 hours)



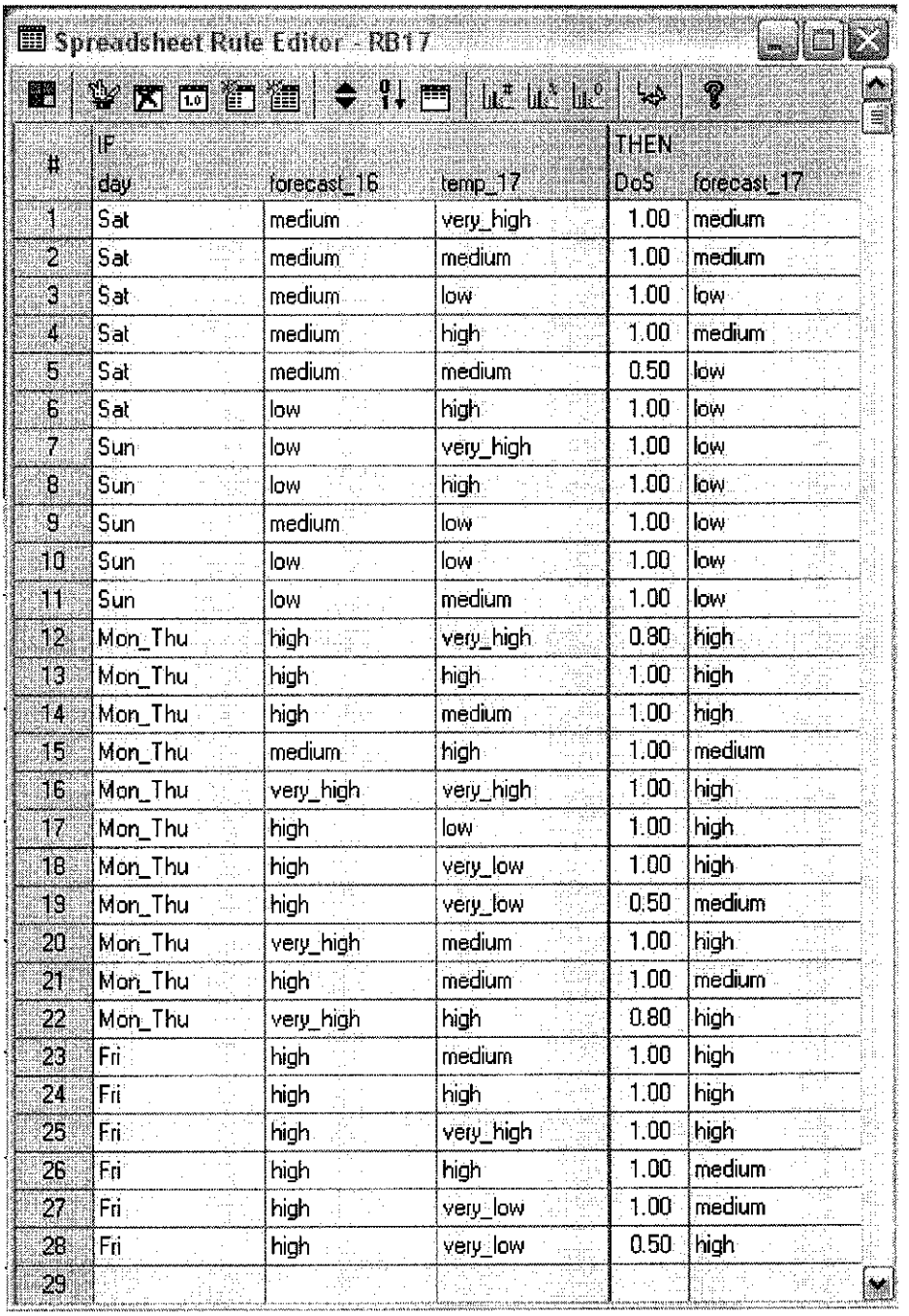
#	IF			THEN	
	day	forecast_14	temp_15	DoS	forecast_15
1	Sat	medium	very_high	1.00	medium
2	Sat	high	very_high	1.00	high
3	Sat	medium	very_low	1.00	medium
4	Sat	low	high	1.00	low
5	Sat	high	very_high	1.00	medium
6	Sat	medium	high	1.00	medium
7	Sat	medium	high	1.00	high
8	Sat	medium	low	1.00	medium
9	Sun	low	very_high	1.00	low
10	Sun	medium	very_high	1.00	medium
11	Sun	low	high	1.00	low
12	Sun	low	high	0.50	medium
13	Sun	low	low	1.00	low
14	Sun	low	low	0.20	medium
15	Mon_Thu	very_high	very_high	1.00	very_high
16	Mon_Thu	very_high	high	1.00	high
17	Mon_Thu	medium	high	1.00	medium
18	Mon_Thu	very_high	medium	1.00	very_high
19	Mon_Thu	high	medium	1.00	high
20	Mon_Thu	high	low	0.80	high
21	Mon_Thu	high	low	1.00	very_high
22	Mon_Thu	very_high	very_low	1.00	very_high
23	Mon_Thu	very_high	very_low	1.00	high
24	Mon_Thu	medium	very_low	0.20	low
25	Mon_Thu	high	low	0.20	medium
26	Mon_Thu	high	high	1.00	high
27	Fri	high	very_high	1.00	high
28	Fri	very_high	very_high	1.00	very_high
29	Fri	medium	very_high	1.00	very_high
30	Fri	medium	high	1.00	high
31	Fri	high	medium	1.00	high
32	Fri	high	low	1.00	high
33	Fri	high	very_low	1.00	high
34	Fri	high	very_low	0.50	very_high
35					

Rule block number 15 Fz1 (forecast result for 1600 hours)



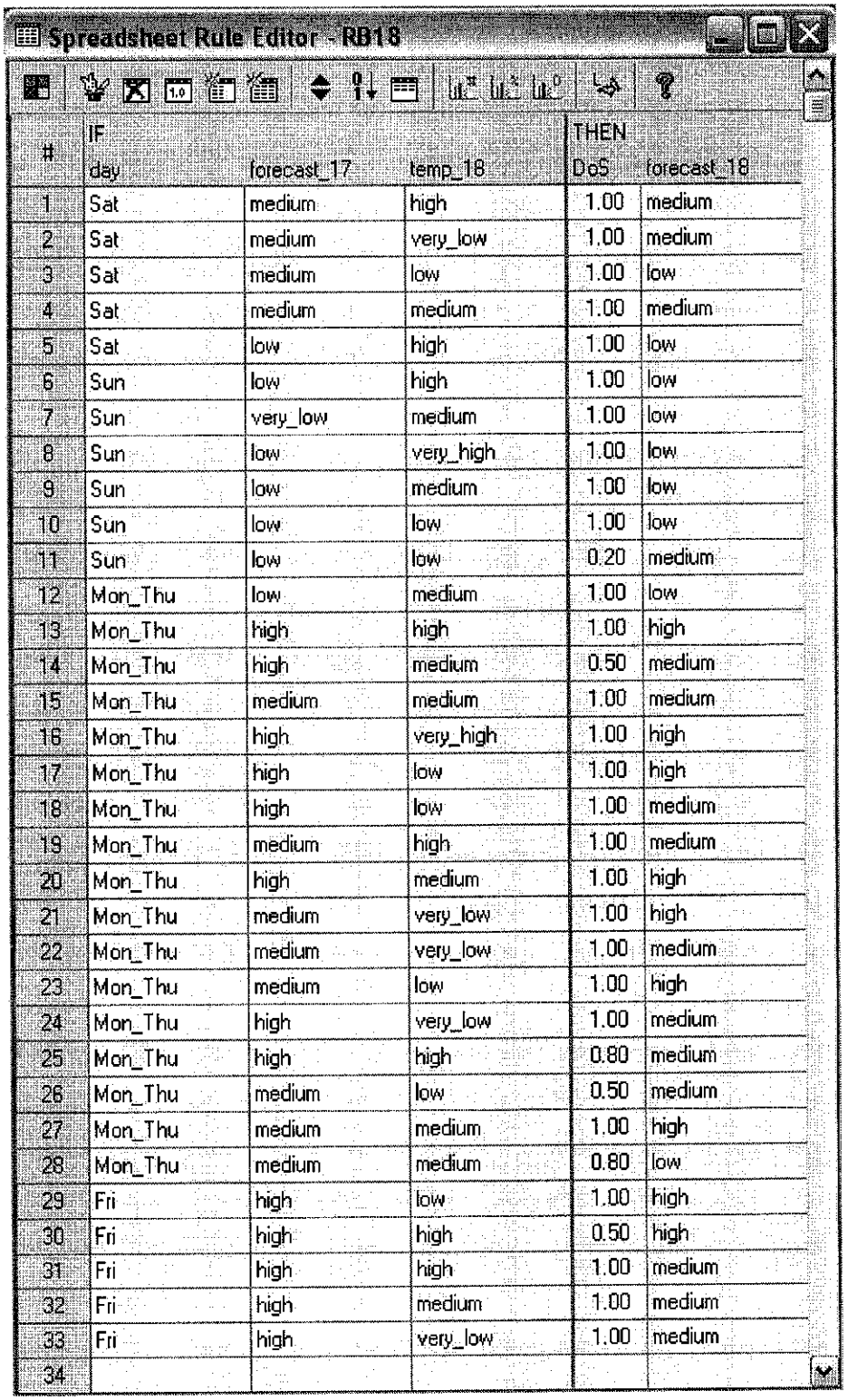
#	IF			THEN	
	day	forecast_15	temp_16	DoS	forecast_16
1	Sat	medium	very_high	1.00	medium
2	Sat	high	very_high	1.00	medium
3	Sat	medium	very_low	1.00	medium
4	Sat	medium	low	0.70	low
5	Sat	medium	low	1.00	medium
6	Sat	medium	medium	1.00	medium
7	Sat	medium	high	0.50	high
8	Sat	medium	high	1.00	medium
9	Sat	low	high	1.00	low
10	Sun	low	high	1.00	low
11	Sun	medium	very_high	1.00	low
12	Sun	medium	high	1.00	low
13	Sun	medium	low	1.00	low
14	Sun	low	low	1.00	low
15	Sun	low	very_low	0.30	very_low
16	Mon_Thu	high	medium	1.00	high
17	Mon_Thu	very_high	high	1.00	high
18	Mon_Thu	very_high	high	0.20	medium
19	Mon_Thu	very_high	medium	1.00	very_high
20	Mon_Thu	very_high	very_high	1.00	high
21	Mon_Thu	very_high	high	0.50	very_high
22	Mon_Thu	very_high	low	1.00	high
23	Mon_Thu	very_high	medium	1.00	high
24	Mon_Thu	high	high	1.00	high
25	Mon_Thu	very_high	very_high	1.00	very_high
26	Mon_Thu	high	low	1.00	high
27	Mon_Thu	high	very_low	1.00	high
28	Mon_Thu	very_high	low	1.00	very_high
29	Mon_Thu	high	very_low	0.10	medium
30	Mon_Thu	medium	low	1.00	low
31	Fri	high	medium	1.00	high
32	Fri	high	high	1.00	high
33	Fri	very_high	very_high	1.00	very_high
34	Fri	high	very_high	1.00	high
35	Fri	very_high	high	1.00	high
36	Fri	high	low	1.00	high
37	Fri	high	very_low	1.00	high
38					

Rule block number 16 Fz1 (forecast result for 1700 hours)



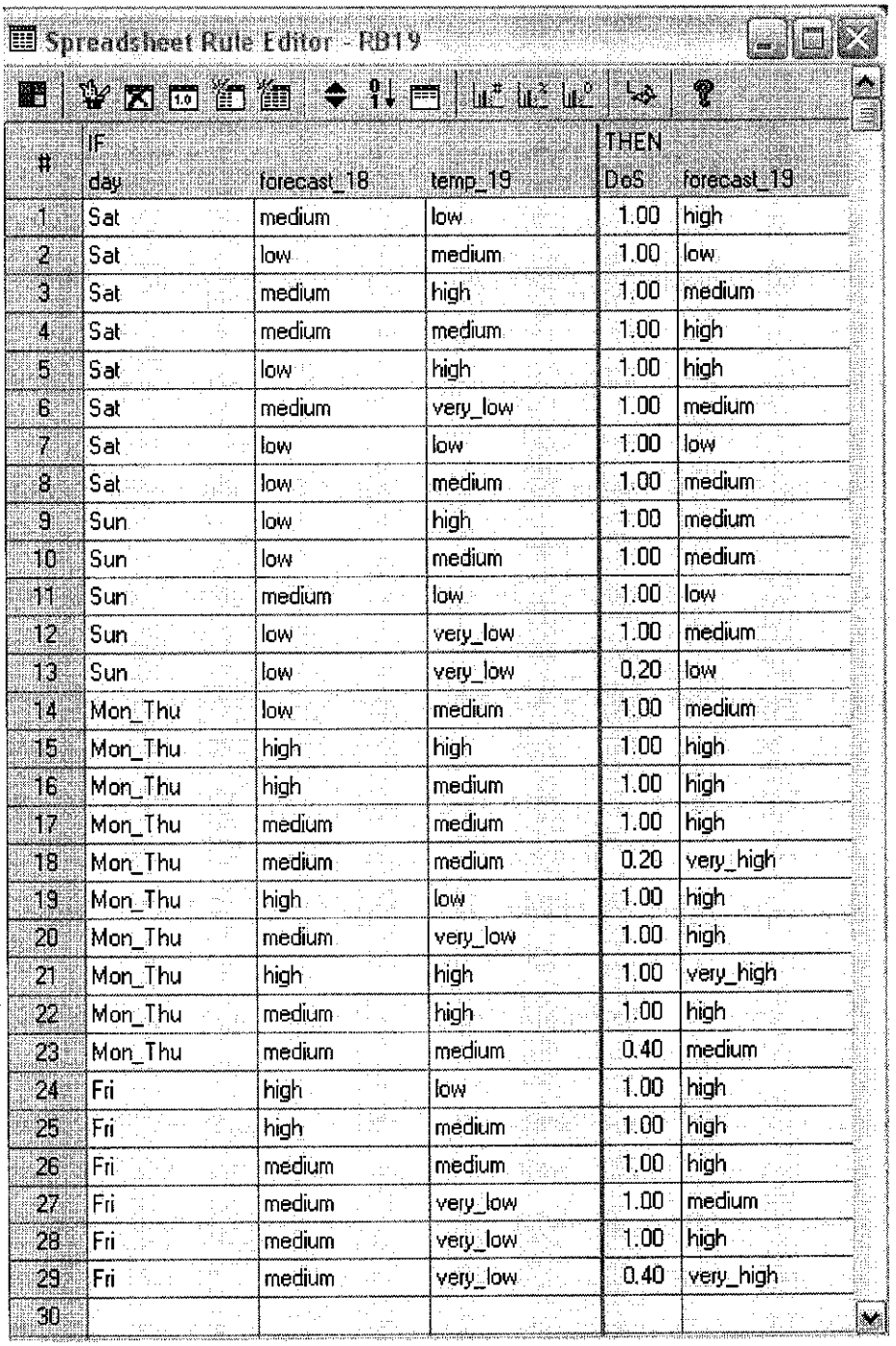
#	IF day	forecast_16	temp_17	THEN DoS	forecast_17
1	Sat	medium	very_high	1.00	medium
2	Sat	medium	medium	1.00	medium
3	Sat	medium	low	1.00	low
4	Sat	medium	high	1.00	medium
5	Sat	medium	medium	0.50	low
6	Sat	low	high	1.00	low
7	Sun	low	very_high	1.00	low
8	Sun	low	high	1.00	low
9	Sun	medium	low	1.00	low
10	Sun	low	low	1.00	low
11	Sun	low	medium	1.00	low
12	Mon_Thu	high	very_high	0.80	high
13	Mon_Thu	high	high	1.00	high
14	Mon_Thu	high	medium	1.00	high
15	Mon_Thu	medium	high	1.00	medium
16	Mon_Thu	very_high	very_high	1.00	high
17	Mon_Thu	high	low	1.00	high
18	Mon_Thu	high	very_low	1.00	high
19	Mon_Thu	high	very_low	0.50	medium
20	Mon_Thu	very_high	medium	1.00	high
21	Mon_Thu	high	medium	1.00	medium
22	Mon_Thu	very_high	high	0.80	high
23	Fri	high	medium	1.00	high
24	Fri	high	high	1.00	high
25	Fri	high	very_high	1.00	high
26	Fri	high	high	1.00	medium
27	Fri	high	very_low	1.00	medium
28	Fri	high	very_low	0.50	high
29					

Rule block number 17 Fz1 (forecast result for 1800 hours)



#	IF day	forecast_17	temp_18	THEN DoS	forecast_18
1	Sat	medium	high	1.00	medium
2	Sat	medium	very_low	1.00	medium
3	Sat	medium	low	1.00	low
4	Sat	medium	medium	1.00	medium
5	Sat	low	high	1.00	low
6	Sun	low	high	1.00	low
7	Sun	very_low	medium	1.00	low
8	Sun	low	very_high	1.00	low
9	Sun	low	medium	1.00	low
10	Sun	low	low	1.00	low
11	Sun	low	low	0.20	medium
12	Mon_Thu	low	medium	1.00	low
13	Mon_Thu	high	high	1.00	high
14	Mon_Thu	high	medium	0.50	medium
15	Mon_Thu	medium	medium	1.00	medium
16	Mon_Thu	high	very_high	1.00	high
17	Mon_Thu	high	low	1.00	high
18	Mon_Thu	high	low	1.00	medium
19	Mon_Thu	medium	high	1.00	medium
20	Mon_Thu	high	medium	1.00	high
21	Mon_Thu	medium	very_low	1.00	high
22	Mon_Thu	medium	very_low	1.00	medium
23	Mon_Thu	medium	low	1.00	high
24	Mon_Thu	high	very_low	1.00	medium
25	Mon_Thu	high	high	0.80	medium
26	Mon_Thu	medium	low	0.50	medium
27	Mon_Thu	medium	medium	1.00	high
28	Mon_Thu	medium	medium	0.80	low
29	Fri	high	low	1.00	high
30	Fri	high	high	0.50	high
31	Fri	high	high	1.00	medium
32	Fri	high	medium	1.00	medium
33	Fri	high	very_low	1.00	medium
34					

Rule block number 18 Fz1 (forecast result for 1900 hours)



#	IF			THEN	
	day	forecast_18	temp_19	DoS	forecast_19
1	Sat	medium	low	1.00	high
2	Sat	low	medium	1.00	low
3	Sat	medium	high	1.00	medium
4	Sat	medium	medium	1.00	high
5	Sat	low	high	1.00	high
6	Sat	medium	very_low	1.00	medium
7	Sat	low	low	1.00	low
8	Sat	low	medium	1.00	medium
9	Sun	low	high	1.00	medium
10	Sun	low	medium	1.00	medium
11	Sun	medium	low	1.00	low
12	Sun	low	very_low	1.00	medium
13	Sun	low	very_low	0.20	low
14	Mon_Thu	low	medium	1.00	medium
15	Mon_Thu	high	high	1.00	high
16	Mon_Thu	high	medium	1.00	high
17	Mon_Thu	medium	medium	1.00	high
18	Mon_Thu	medium	medium	0.20	very_high
19	Mon_Thu	high	low	1.00	high
20	Mon_Thu	medium	very_low	1.00	high
21	Mon_Thu	high	high	1.00	very_high
22	Mon_Thu	medium	high	1.00	high
23	Mon_Thu	medium	medium	0.40	medium
24	Fri	high	low	1.00	high
25	Fri	high	medium	1.00	high
26	Fri	medium	medium	1.00	high
27	Fri	medium	very_low	1.00	medium
28	Fri	medium	very_low	1.00	high
29	Fri	medium	very_low	0.40	very_high
30					

Rule block number 19 for Fz1 (forecast result for 2000 hours)

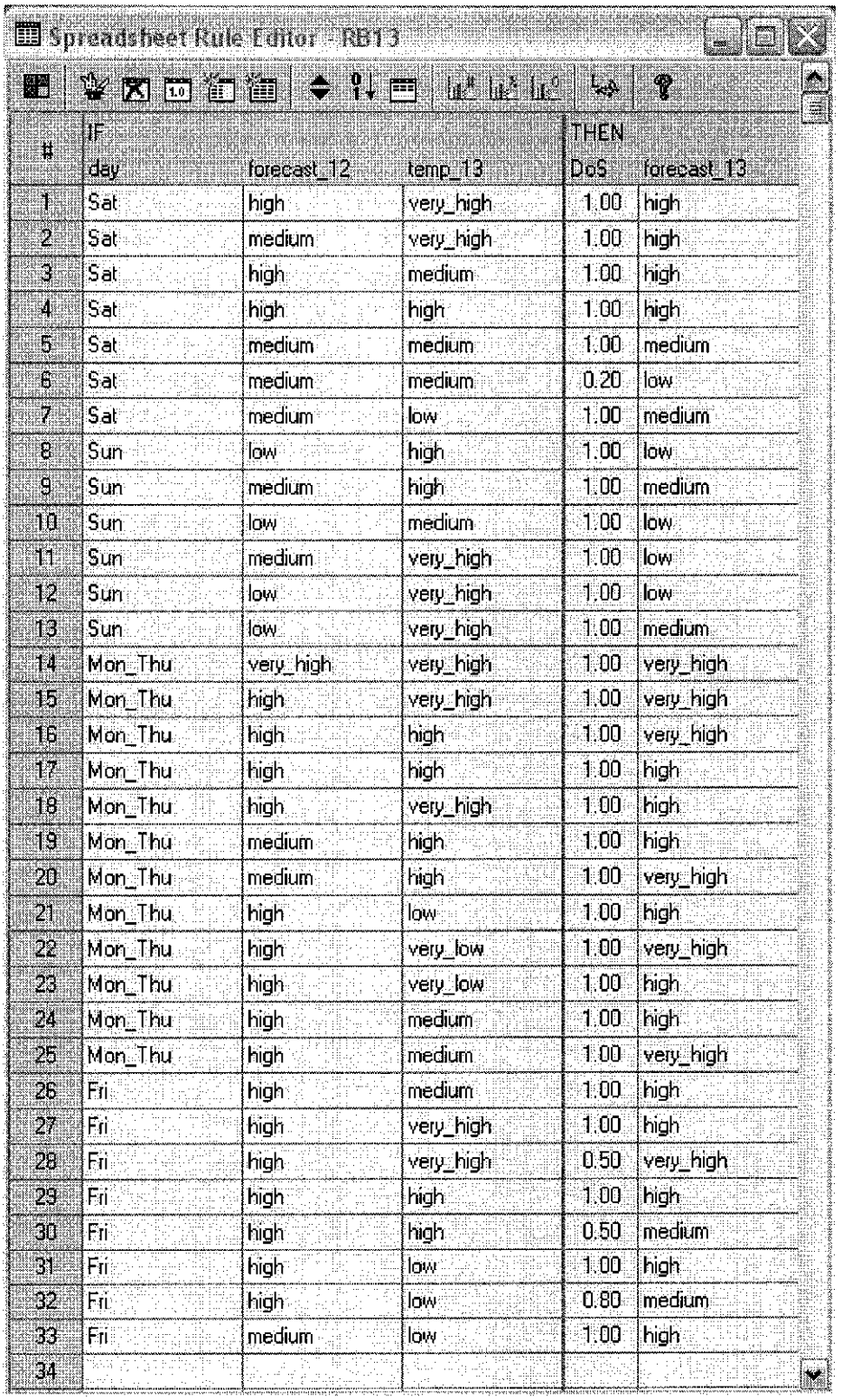
APPENDIX B

FUZZY RULES –FZ2 (17 HOURS AHEAD LOAD FORECAST)

Spreadsheet Rule Editor - RB12

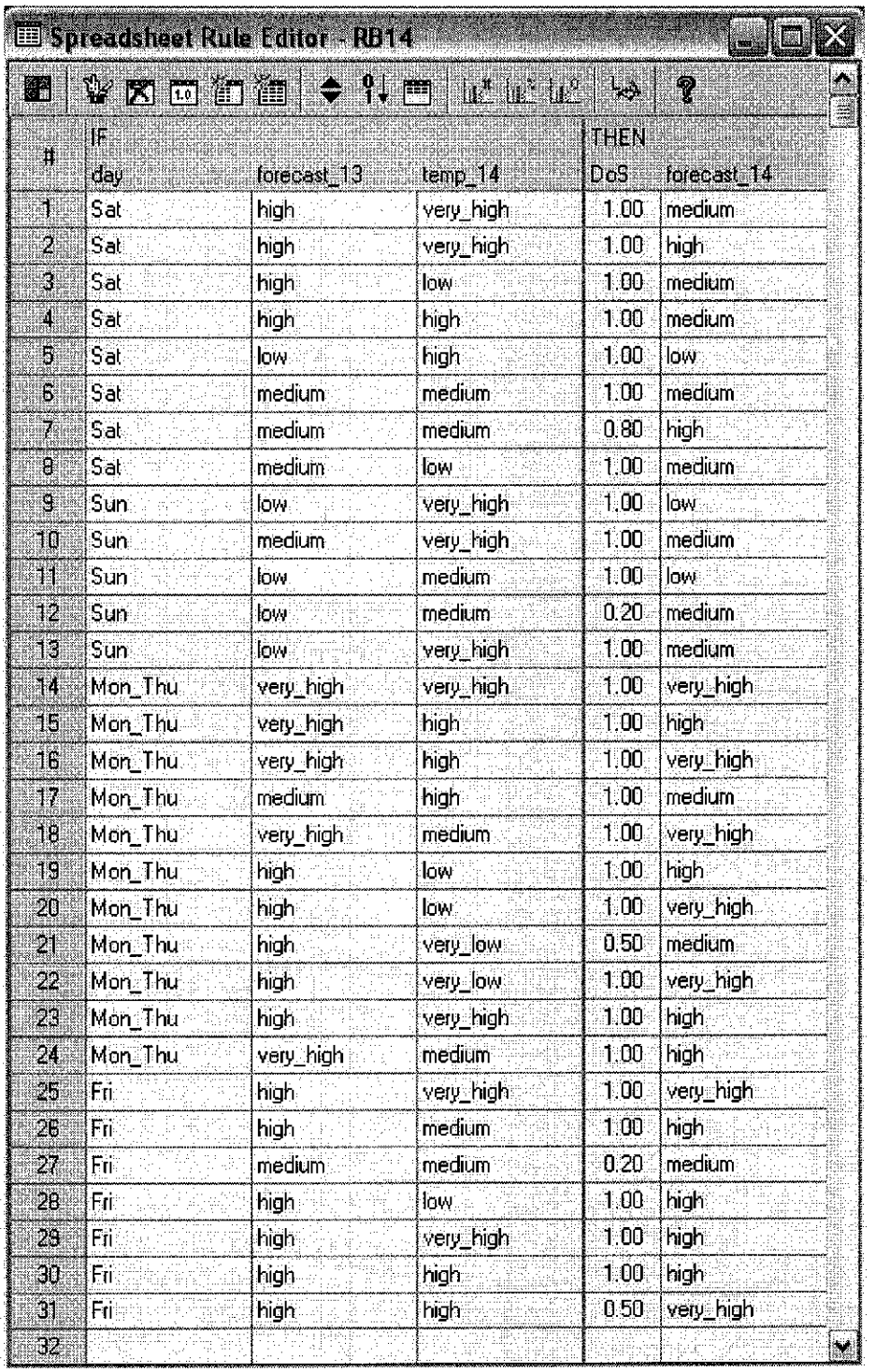
#	IF			THEN	
	day	load	temp_12	DoS	forecast_12
1	Sat	high	very_high	1.00	high
2	Sat	high	very_high	1.00	medium
3	Sat	high	medium	0.50	high
4	Sat	high	medium	1.00	medium
5	Sat	low	high	1.00	low
6	Sat	high	high	1.00	high
7	Sat	medium	medium	1.00	medium
8	Sat	medium	medium	0.30	low
9	Sun	low	high	1.00	low
10	Sun	low	very_high	1.00	medium
11	Sun	medium	very_high	1.00	medium
12	Sun	low	high	0.50	medium
13	Sun	low	medium	1.00	low
14	Sun	low	very_high	1.00	low
15	Sun	low	high	0.30	very_low
16	Sun	medium	very_high	1.00	low
17	Mon_Thu	very_high	very_high	1.00	very_high
18	Mon_Thu	very_high	very_high	0.80	high
19	Mon_Thu	high	medium	1.00	high
20	Mon_Thu	high	high	1.00	high
21	Mon_Thu	high	high	0.40	medium
22	Mon_Thu	medium	high	1.00	medium
23	Mon_Thu	high	very_high	1.00	high
24	Mon_Thu	very_high	high	0.80	high
25	Mon_Thu	very_high	high	0.50	very_high
26	Fri	very_high	high	1.00	high
27	Fri	high	high	1.00	high
28	Fri	high	low	1.00	high
29	Fri	high	low	1.00	medium
30	Fri	high	very_low	1.00	high
31	Fri	high	very_high	1.00	high
32	Fri	very_high	very_high	1.00	high
33	Fri	medium	very_high	0.20	high
34					

Rule block number 1 for Fz2 (forecast result for 1300 hours)



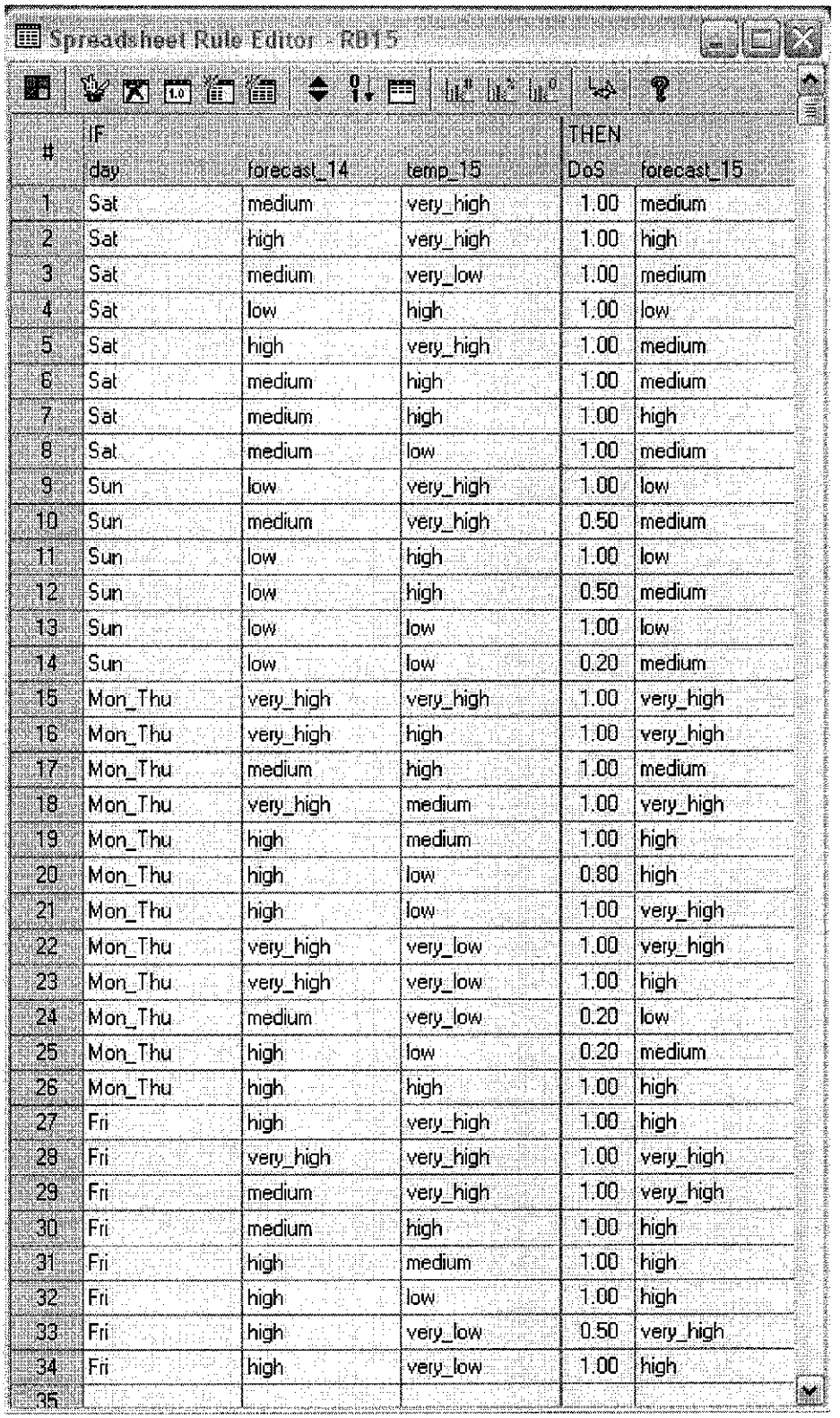
#	IF			THEN	
	day	forecast_12	temp_13	DoS	forecast_13
1	Sat	high	very_high	1.00	high
2	Sat	medium	very_high	1.00	high
3	Sat	high	medium	1.00	high
4	Sat	high	high	1.00	high
5	Sat	medium	medium	1.00	medium
6	Sat	medium	medium	0.20	low
7	Sat	medium	low	1.00	medium
8	Sun	low	high	1.00	low
9	Sun	medium	high	1.00	medium
10	Sun	low	medium	1.00	low
11	Sun	medium	very_high	1.00	low
12	Sun	low	very_high	1.00	low
13	Sun	low	very_high	1.00	medium
14	Mon_Thu	very_high	very_high	1.00	very_high
15	Mon_Thu	high	very_high	1.00	very_high
16	Mon_Thu	high	high	1.00	very_high
17	Mon_Thu	high	high	1.00	high
18	Mon_Thu	high	very_high	1.00	high
19	Mon_Thu	medium	high	1.00	high
20	Mon_Thu	medium	high	1.00	very_high
21	Mon_Thu	high	low	1.00	high
22	Mon_Thu	high	very_low	1.00	very_high
23	Mon_Thu	high	very_low	1.00	high
24	Mon_Thu	high	medium	1.00	high
25	Mon_Thu	high	medium	1.00	very_high
26	Fri	high	medium	1.00	high
27	Fri	high	very_high	1.00	high
28	Fri	high	very_high	0.50	very_high
29	Fri	high	high	1.00	high
30	Fri	high	high	0.50	medium
31	Fri	high	low	1.00	high
32	Fri	high	low	0.80	medium
33	Fri	medium	low	1.00	high
34					

Rule block number 2 for Fz2 (forecast result for 1400 hours)



#	IF			THEN	
	day	forecast_13	temp_14	DoS	forecast_14
1	Sat	high	very_high	1.00	medium
2	Sat	high	very_high	1.00	high
3	Sat	high	low	1.00	medium
4	Sat	high	high	1.00	medium
5	Sat	low	high	1.00	low
6	Sat	medium	medium	1.00	medium
7	Sat	medium	medium	0.80	high
8	Sat	medium	low	1.00	medium
9	Sun	low	very_high	1.00	low
10	Sun	medium	very_high	1.00	medium
11	Sun	low	medium	1.00	low
12	Sun	low	medium	0.20	medium
13	Sun	low	very_high	1.00	medium
14	Mon_Thu	very_high	very_high	1.00	very_high
15	Mon_Thu	very_high	high	1.00	high
16	Mon_Thu	very_high	high	1.00	very_high
17	Mon_Thu	medium	high	1.00	medium
18	Mon_Thu	very_high	medium	1.00	very_high
19	Mon_Thu	high	low	1.00	high
20	Mon_Thu	high	low	1.00	very_high
21	Mon_Thu	high	very_low	0.50	medium
22	Mon_Thu	high	very_low	1.00	very_high
23	Mon_Thu	high	very_high	1.00	high
24	Mon_Thu	very_high	medium	1.00	high
25	Fri	high	very_high	1.00	very_high
26	Fri	high	medium	1.00	high
27	Fri	medium	medium	0.20	medium
28	Fri	high	low	1.00	high
29	Fri	high	very_high	1.00	high
30	Fri	high	high	1.00	high
31	Fri	high	high	0.50	very_high
32					

Rule block number 3 for Fz2 (forecast result for 1500 hours)



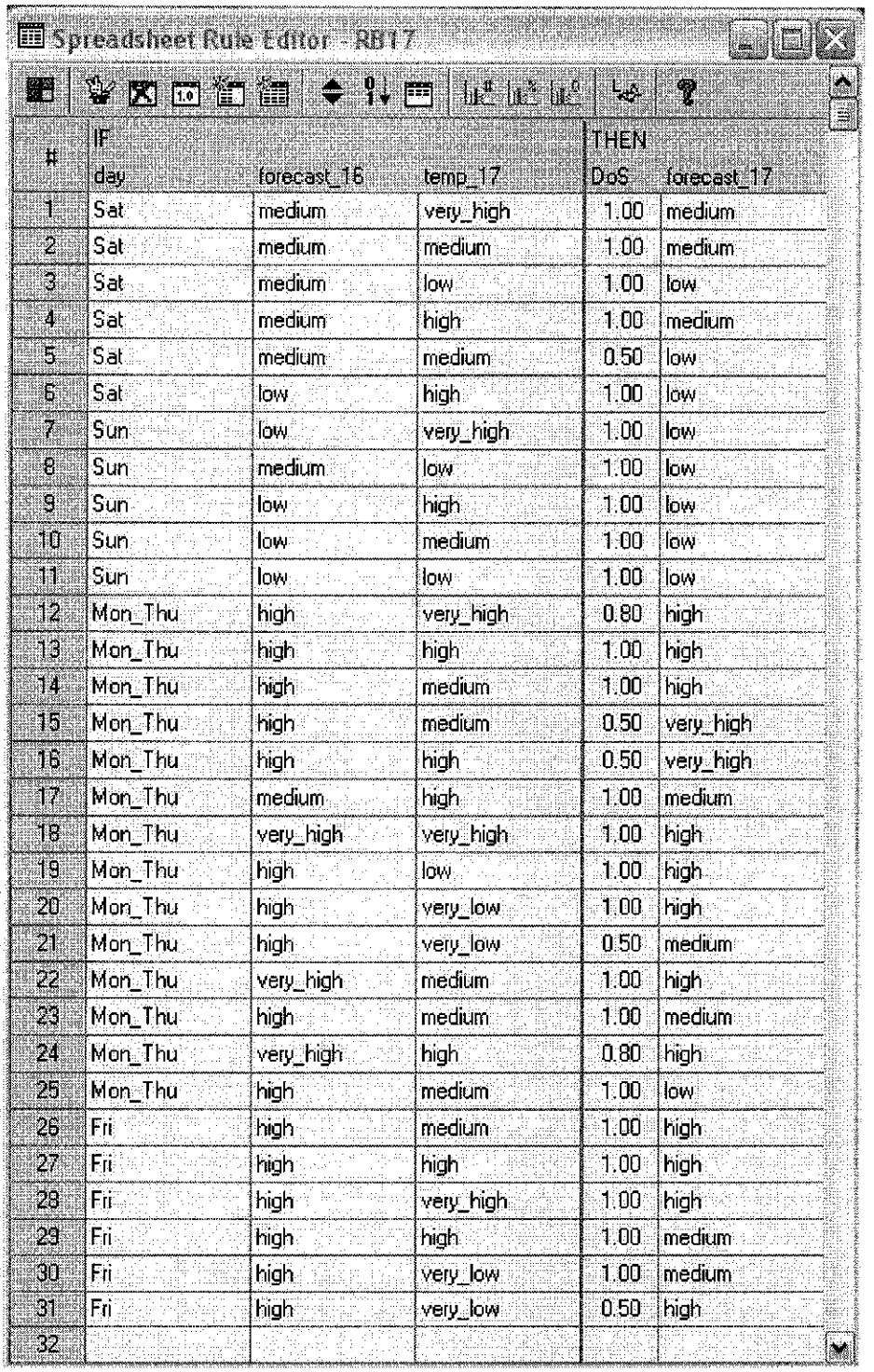
#	IF day	forecast_14	temp_15	THEN DoS	forecast_15
1	Sat	medium	very_high	1.00	medium
2	Sat	high	very_high	1.00	high
3	Sat	medium	very_low	1.00	medium
4	Sat	low	high	1.00	low
5	Sat	high	very_high	1.00	medium
6	Sat	medium	high	1.00	medium
7	Sat	medium	high	1.00	high
8	Sat	medium	low	1.00	medium
9	Sun	low	very_high	1.00	low
10	Sun	medium	very_high	0.50	medium
11	Sun	low	high	1.00	low
12	Sun	low	high	0.50	medium
13	Sun	low	low	1.00	low
14	Sun	low	low	0.20	medium
15	Mon_Thu	very_high	very_high	1.00	very_high
16	Mon_Thu	very_high	high	1.00	very_high
17	Mon_Thu	medium	high	1.00	medium
18	Mon_Thu	very_high	medium	1.00	very_high
19	Mon_Thu	high	medium	1.00	high
20	Mon_Thu	high	low	0.80	high
21	Mon_Thu	high	low	1.00	very_high
22	Mon_Thu	very_high	very_low	1.00	very_high
23	Mon_Thu	very_high	very_low	1.00	high
24	Mon_Thu	medium	very_low	0.20	low
25	Mon_Thu	high	low	0.20	medium
26	Mon_Thu	high	high	1.00	high
27	Fri	high	very_high	1.00	high
28	Fri	very_high	very_high	1.00	very_high
29	Fri	medium	very_high	1.00	very_high
30	Fri	medium	high	1.00	high
31	Fri	high	medium	1.00	high
32	Fri	high	low	1.00	high
33	Fri	high	very_low	0.50	very_high
34	Fri	high	very_low	1.00	high
35					

Rule block number 4 for Fz2 (forecast result for 1600 hours)

Spreadsheet Rule Editor - RB16

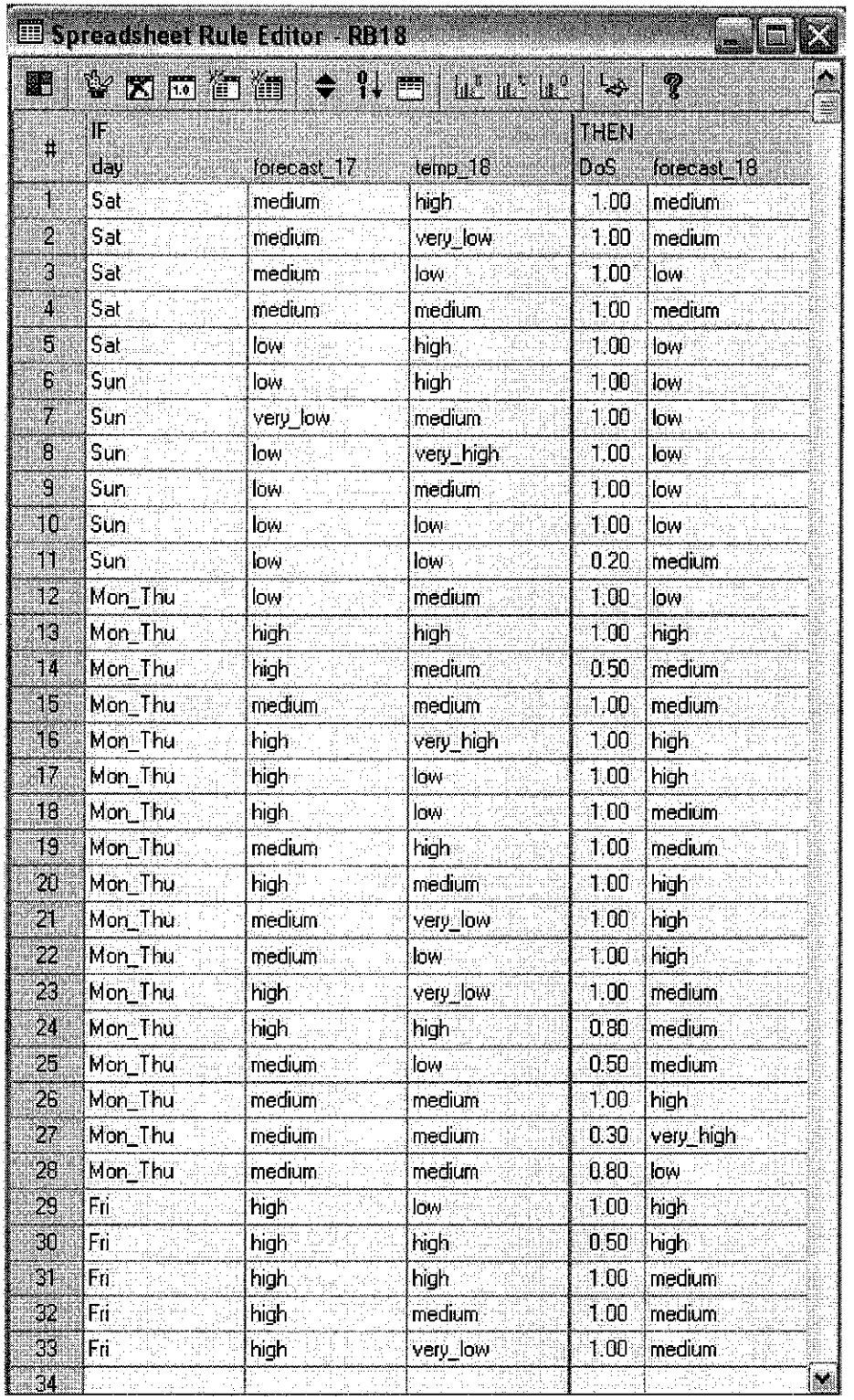
#	IF day	forecast_15	temp_16	THEN DoS	forecast_16
1	Sat	medium	very_high	1.00	medium
2	Sat	high	very_high	1.00	medium
3	Sat	medium	very_low	1.00	medium
4	Sat	medium	low	0.70	low
5	Sat	medium	low	1.00	medium
6	Sat	medium	medium	1.00	medium
7	Sat	medium	high	0.50	high
8	Sat	medium	high	1.00	medium
9	Sat	low	high	1.00	low
10	Sun	low	high	1.00	low
11	Sun	medium	very_high	1.00	low
12	Sun	medium	high	1.00	low
13	Sun	medium	low	1.00	low
14	Sun	low	low	1.00	low
15	Sun	low	very_low	0.30	very_low
16	Mon_Thu	high	medium	1.00	high
17	Mon_Thu	very_high	high	1.00	high
18	Mon_Thu	very_high	high	0.20	medium
19	Mon_Thu	very_high	medium	1.00	very_high
20	Mon_Thu	very_high	very_high	1.00	high
21	Mon_Thu	very_high	high	0.50	very_high
22	Mon_Thu	very_high	low	1.00	high
23	Mon_Thu	very_high	medium	1.00	high
24	Mon_Thu	high	high	1.00	high
25	Mon_Thu	very_high	very_high	0.50	very_high
26	Mon_Thu	high	low	1.00	high
27	Mon_Thu	high	very_low	1.00	high
28	Mon_Thu	very_high	low	1.00	very_high
29	Mon_Thu	high	very_low	0.10	medium
30	Mon_Thu	medium	low	1.00	low
31	Fri	high	medium	1.00	high
32	Fri	high	high	1.00	high
33	Fri	very_high	very_high	1.00	very_high
34	Fri	high	very_high	1.00	high
35	Fri	very_high	high	1.00	high
36	Fri	very_high	very_low	1.00	high
37					

Rule block number 5 for Fz2 (forecast result for 1700 hours)



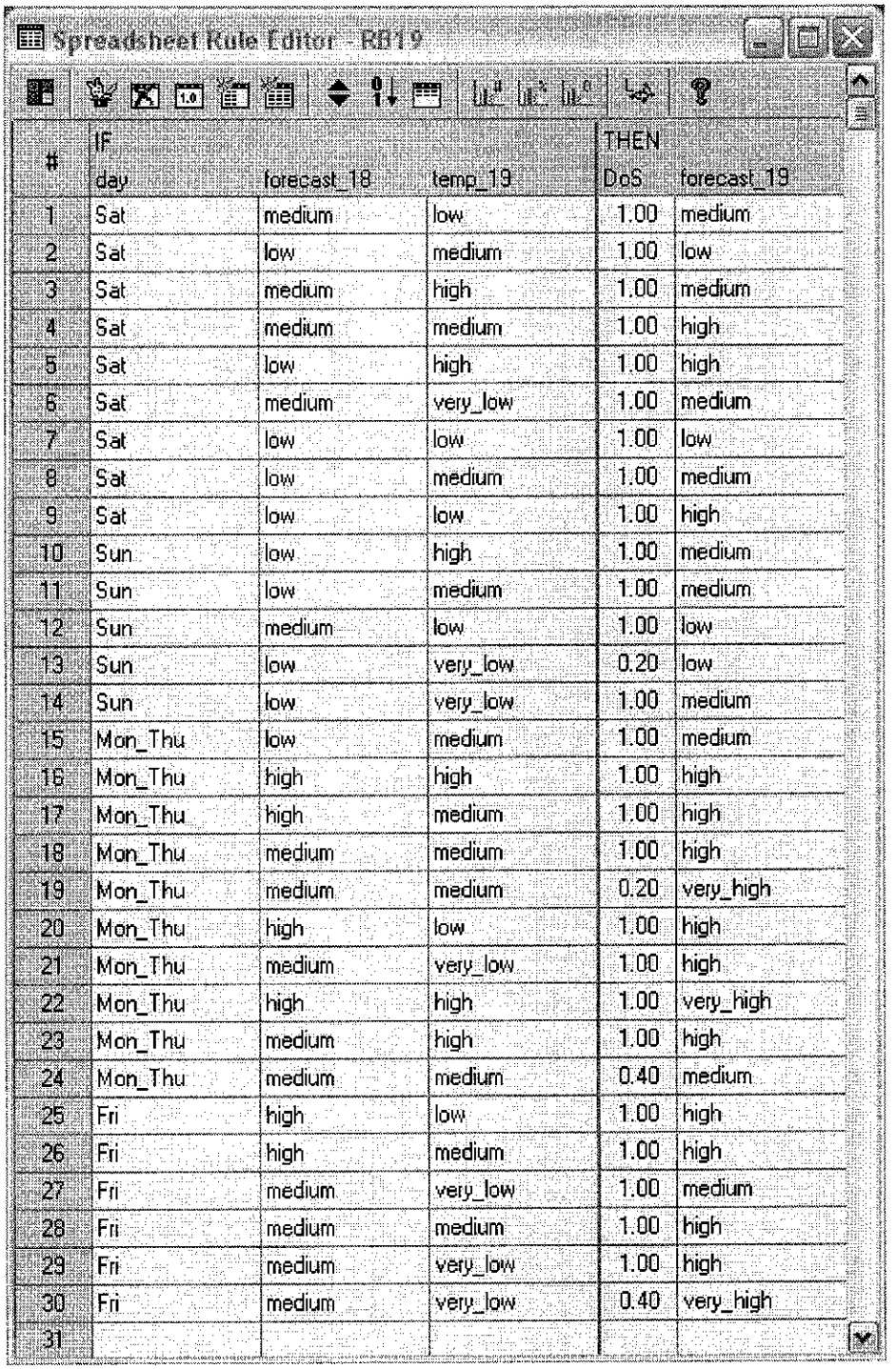
#	IF			THEN	
	day	forecast_16	temp_17	DoS	forecast_17
1	Sat	medium	very_high	1.00	medium
2	Sat	medium	medium	1.00	medium
3	Sat	medium	low	1.00	low
4	Sat	medium	high	1.00	medium
5	Sat	medium	medium	0.50	low
6	Sat	low	high	1.00	low
7	Sun	low	very_high	1.00	low
8	Sun	medium	low	1.00	low
9	Sun	low	high	1.00	low
10	Sun	low	medium	1.00	low
11	Sun	low	low	1.00	low
12	Mon_Thu	high	very_high	0.80	high
13	Mon_Thu	high	high	1.00	high
14	Mon_Thu	high	medium	1.00	high
15	Mon_Thu	high	medium	0.50	very_high
16	Mon_Thu	high	high	0.50	very_high
17	Mon_Thu	medium	high	1.00	medium
18	Mon_Thu	very_high	very_high	1.00	high
19	Mon_Thu	high	low	1.00	high
20	Mon_Thu	high	very_low	1.00	high
21	Mon_Thu	high	very_low	0.50	medium
22	Mon_Thu	very_high	medium	1.00	high
23	Mon_Thu	high	medium	1.00	medium
24	Mon_Thu	very_high	high	0.80	high
25	Mon_Thu	high	medium	1.00	low
26	Fri	high	medium	1.00	high
27	Fri	high	high	1.00	high
28	Fri	high	very_high	1.00	high
29	Fri	high	high	1.00	medium
30	Fri	high	very_low	1.00	medium
31	Fri	high	very_low	0.50	high
32					

Rule block number 6 for Fz2 (forecast result for 1800 hours)



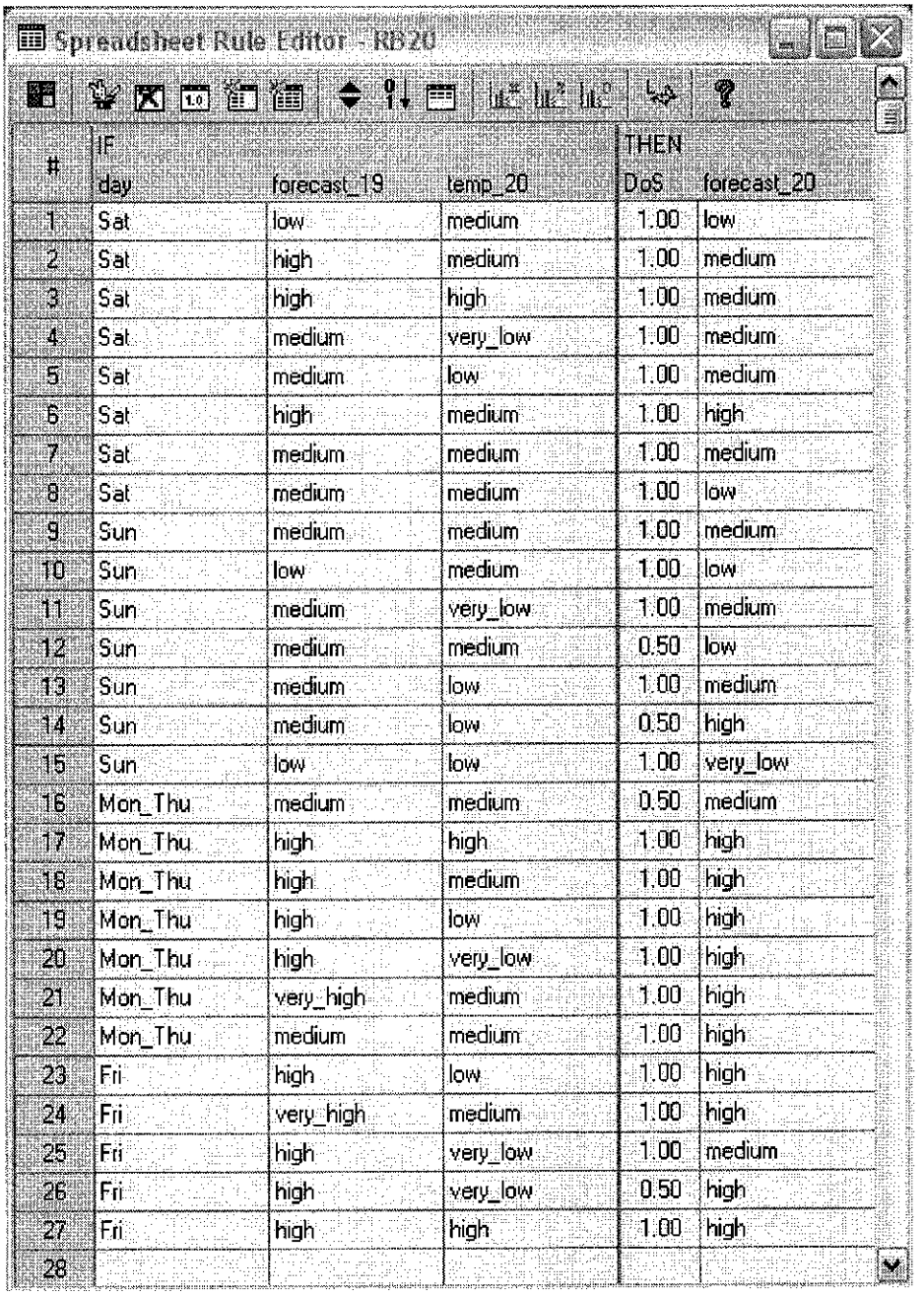
#	IF			THEN	
	day	forecast_17	temp_18	DoS	forecast_18
1	Sat	medium	high	1.00	medium
2	Sat	medium	very_low	1.00	medium
3	Sat	medium	low	1.00	low
4	Sat	medium	medium	1.00	medium
5	Sat	low	high	1.00	low
6	Sun	low	high	1.00	low
7	Sun	very_low	medium	1.00	low
8	Sun	low	very_high	1.00	low
9	Sun	low	medium	1.00	low
10	Sun	low	low	1.00	low
11	Sun	low	low	0.20	medium
12	Mon_Thu	low	medium	1.00	low
13	Mon_Thu	high	high	1.00	high
14	Mon_Thu	high	medium	0.50	medium
15	Mon_Thu	medium	medium	1.00	medium
16	Mon_Thu	high	very_high	1.00	high
17	Mon_Thu	high	low	1.00	high
18	Mon_Thu	high	low	1.00	medium
19	Mon_Thu	medium	high	1.00	medium
20	Mon_Thu	high	medium	1.00	high
21	Mon_Thu	medium	very_low	1.00	high
22	Mon_Thu	medium	low	1.00	high
23	Mon_Thu	high	very_low	1.00	medium
24	Mon_Thu	high	high	0.80	medium
25	Mon_Thu	medium	low	0.50	medium
26	Mon_Thu	medium	medium	1.00	high
27	Mon_Thu	medium	medium	0.30	very_high
28	Mon_Thu	medium	medium	0.80	low
29	Fri	high	low	1.00	high
30	Fri	high	high	0.50	high
31	Fri	high	high	1.00	medium
32	Fri	high	medium	1.00	medium
33	Fri	high	very_low	1.00	medium
34					

Rule block number 7 for Fz2 (forecast result for 1900 hours)



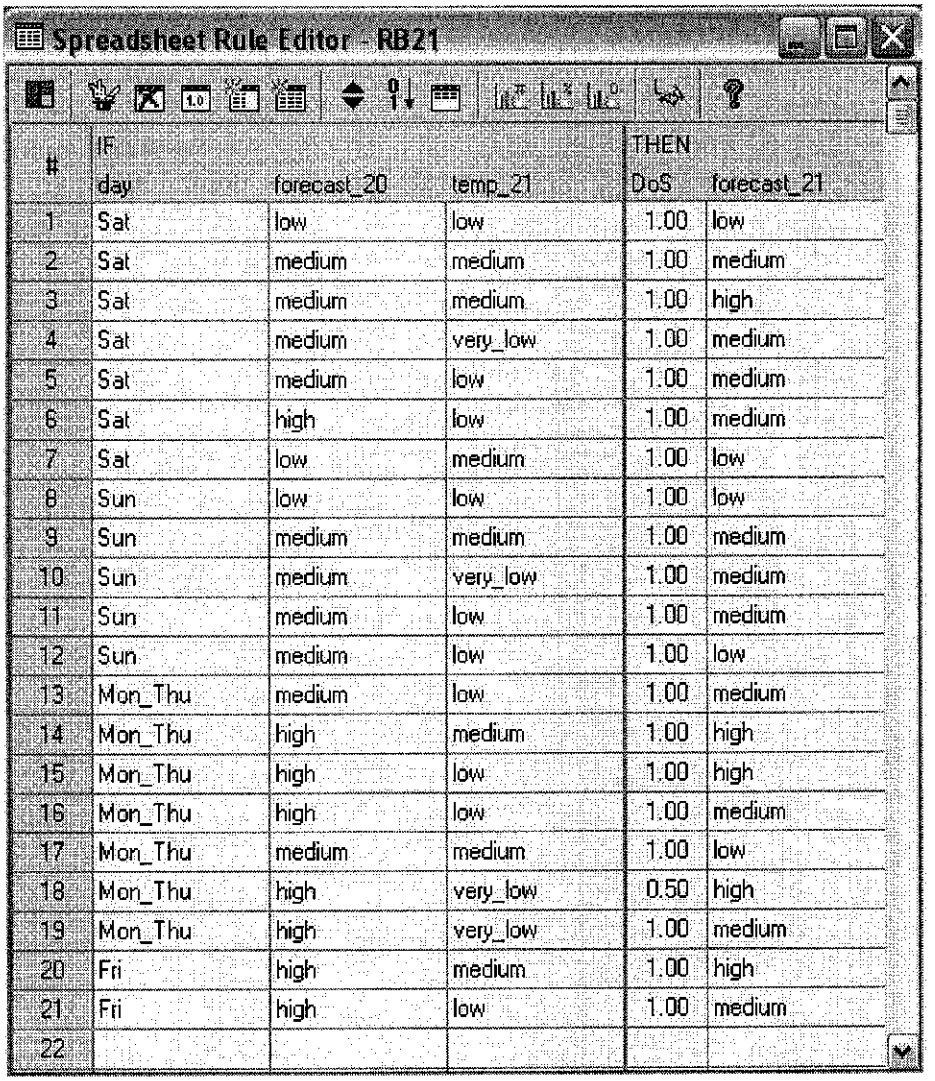
#	IF day	forecast_18	temp_19	THEN DoS	forecast_19
1	Sat	medium	low	1.00	medium
2	Sat	low	medium	1.00	low
3	Sat	medium	high	1.00	medium
4	Sat	medium	medium	1.00	high
5	Sat	low	high	1.00	high
6	Sat	medium	very_low	1.00	medium
7	Sat	low	low	1.00	low
8	Sat	low	medium	1.00	medium
9	Sat	low	low	1.00	high
10	Sun	low	high	1.00	medium
11	Sun	low	medium	1.00	medium
12	Sun	medium	low	1.00	low
13	Sun	low	very_low	0.20	low
14	Sun	low	very_low	1.00	medium
15	Mon_Thu	low	medium	1.00	medium
16	Mon_Thu	high	high	1.00	high
17	Mon_Thu	high	medium	1.00	high
18	Mon_Thu	medium	medium	1.00	high
19	Mon_Thu	medium	medium	0.20	very_high
20	Mon_Thu	high	low	1.00	high
21	Mon_Thu	medium	very_low	1.00	high
22	Mon_Thu	high	high	1.00	very_high
23	Mon_Thu	medium	high	1.00	high
24	Mon_Thu	medium	medium	0.40	medium
25	Fri	high	low	1.00	high
26	Fri	high	medium	1.00	high
27	Fri	medium	very_low	1.00	medium
28	Fri	medium	medium	1.00	high
29	Fri	medium	very_low	1.00	high
30	Fri	medium	very_low	0.40	very_high
31					

Rule block number 8 for Fz2 (forecast result for 2000 hours)



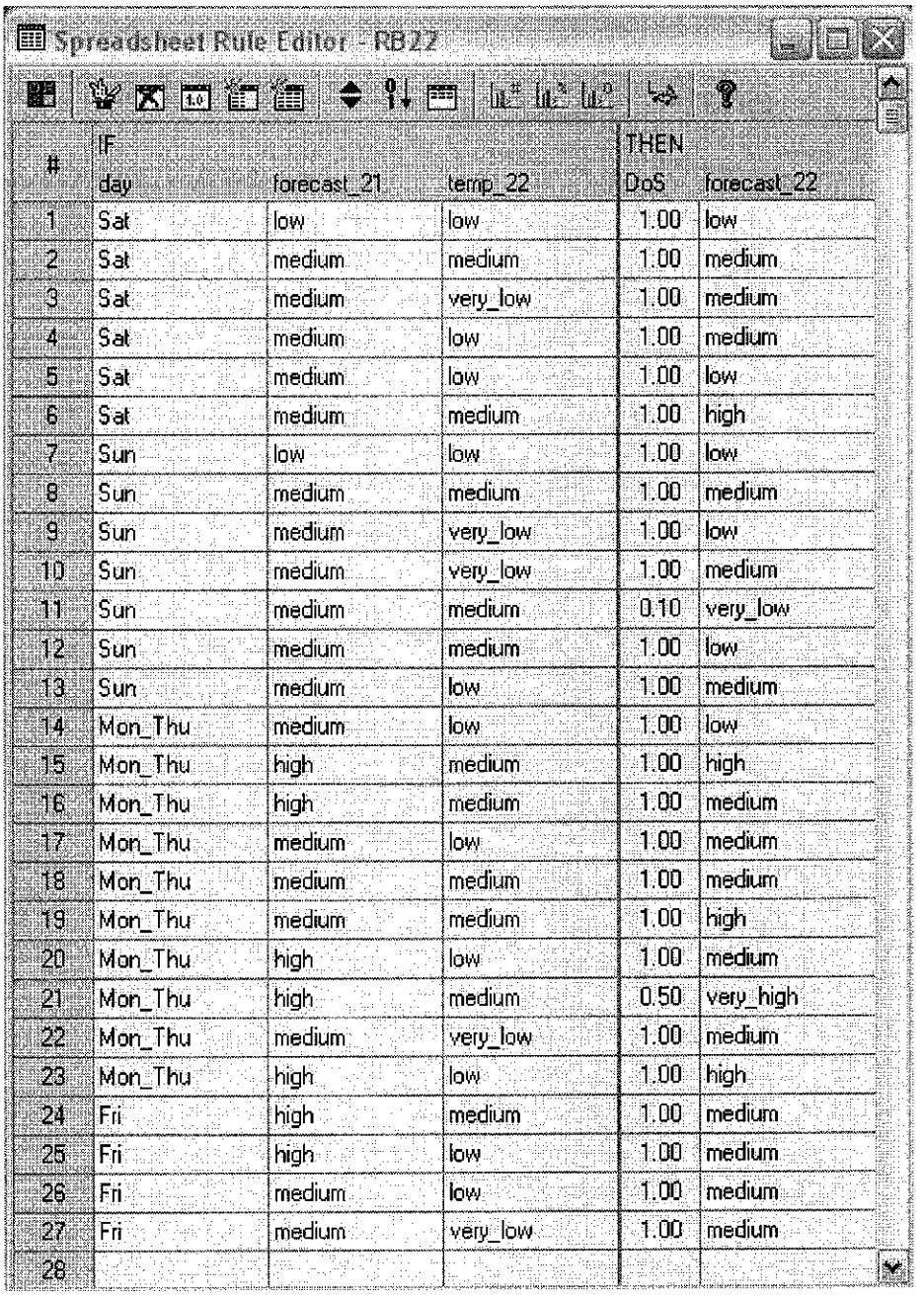
#	IF day	forecast_19	temp_20	THEN DoS	forecast_20
1	Sat	low	medium	1.00	low
2	Sat	high	medium	1.00	medium
3	Sat	high	high	1.00	medium
4	Sat	medium	very_low	1.00	medium
5	Sat	medium	low	1.00	medium
6	Sat	high	medium	1.00	high
7	Sat	medium	medium	1.00	medium
8	Sat	medium	medium	1.00	low
9	Sun	medium	medium	1.00	medium
10	Sun	low	medium	1.00	low
11	Sun	medium	very_low	1.00	medium
12	Sun	medium	medium	0.50	low
13	Sun	medium	low	1.00	medium
14	Sun	medium	low	0.50	high
15	Sun	low	low	1.00	very_low
16	Mon_Thu	medium	medium	0.50	medium
17	Mon_Thu	high	high	1.00	high
18	Mon_Thu	high	medium	1.00	high
19	Mon_Thu	high	low	1.00	high
20	Mon_Thu	high	very_low	1.00	high
21	Mon_Thu	very_high	medium	1.00	high
22	Mon_Thu	medium	medium	1.00	high
23	Fri	high	low	1.00	high
24	Fri	very_high	medium	1.00	high
25	Fri	high	very_low	1.00	medium
26	Fri	high	very_low	0.50	high
27	Fri	high	high	1.00	high
28					

Rule block number 9 for Fz2 (forecast result for 2100 hours)



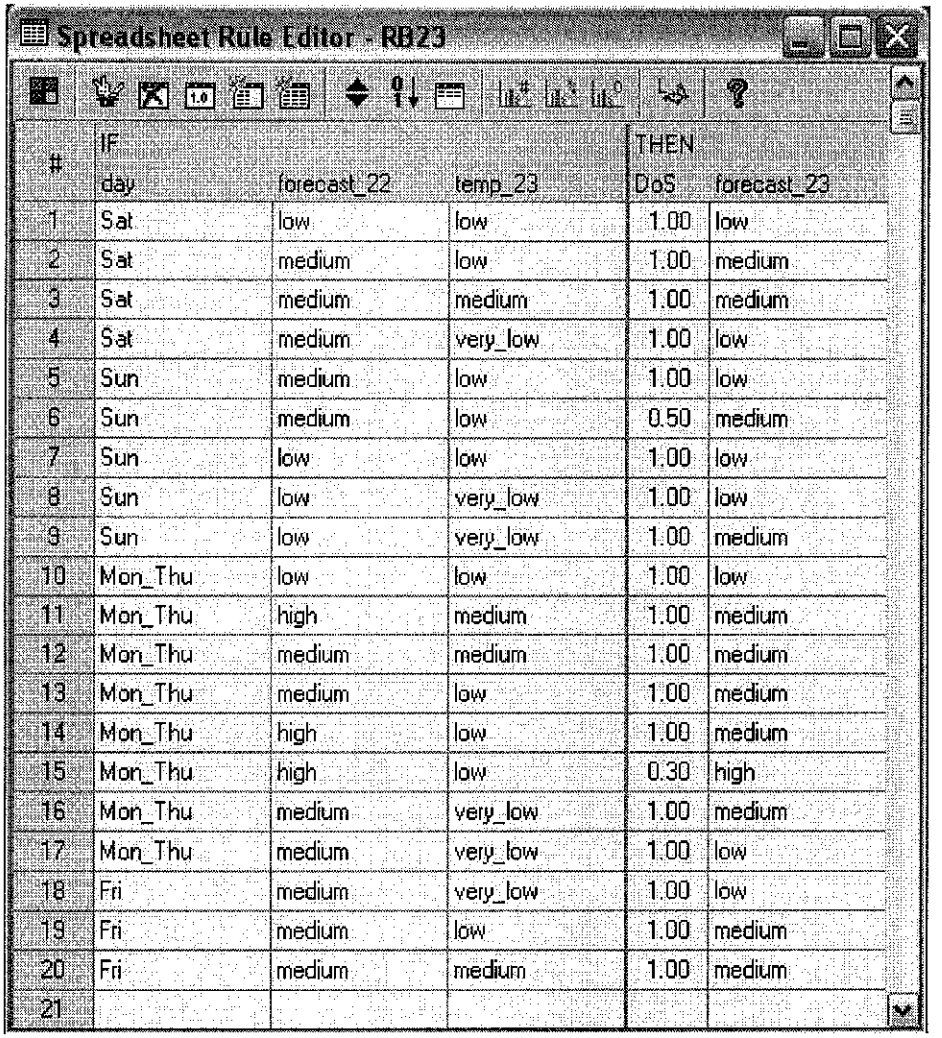
#	IF day	forecast_20	temp_21	THEN DoS	forecast_21
1	Sat	low	low	1.00	low
2	Sat	medium	medium	1.00	medium
3	Sat	medium	medium	1.00	high
4	Sat	medium	very_low	1.00	medium
5	Sat	medium	low	1.00	medium
6	Sat	high	low	1.00	medium
7	Sat	low	medium	1.00	low
8	Sun	low	low	1.00	low
9	Sun	medium	medium	1.00	medium
10	Sun	medium	very_low	1.00	medium
11	Sun	medium	low	1.00	medium
12	Sun	medium	low	1.00	low
13	Mon_Thu	medium	low	1.00	medium
14	Mon_Thu	high	medium	1.00	high
15	Mon_Thu	high	low	1.00	high
16	Mon_Thu	high	low	1.00	medium
17	Mon_Thu	medium	medium	1.00	low
18	Mon_Thu	high	very_low	0.50	high
19	Mon_Thu	high	very_low	1.00	medium
20	Fri	high	medium	1.00	high
21	Fri	high	low	1.00	medium
22					

Rule block number 10 for Fz2 (forecast result for 2200 hours)



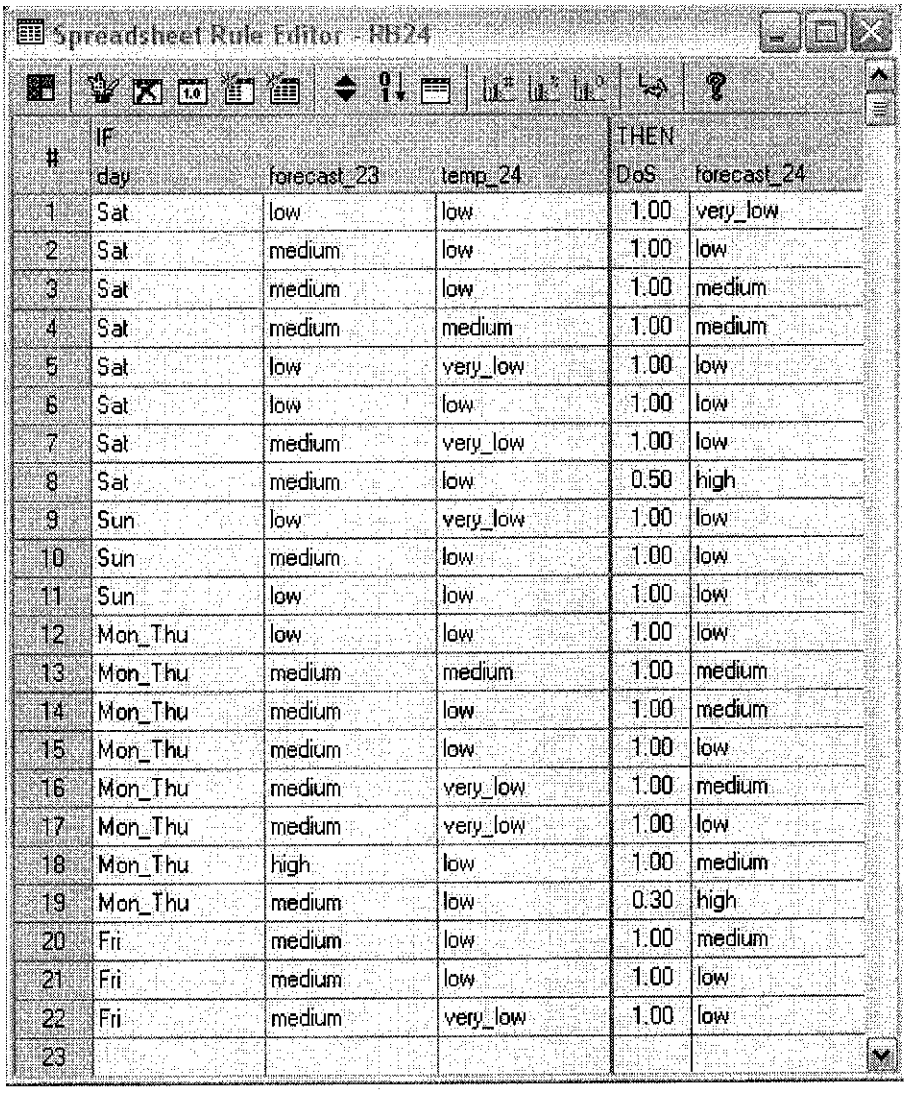
#	IF			THEN	
	day	forecast_21	temp_22	DoS	forecast_22
1	Sat	low	low	1.00	low
2	Sat	medium	medium	1.00	medium
3	Sat	medium	very_low	1.00	medium
4	Sat	medium	low	1.00	medium
5	Sat	medium	low	1.00	low
6	Sat	medium	medium	1.00	high
7	Sun	low	low	1.00	low
8	Sun	medium	medium	1.00	medium
9	Sun	medium	very_low	1.00	low
10	Sun	medium	very_low	1.00	medium
11	Sun	medium	medium	0.10	very_low
12	Sun	medium	medium	1.00	low
13	Sun	medium	low	1.00	medium
14	Mon_Thu	medium	low	1.00	low
15	Mon_Thu	high	medium	1.00	high
16	Mon_Thu	high	medium	1.00	medium
17	Mon_Thu	medium	low	1.00	medium
18	Mon_Thu	medium	medium	1.00	medium
19	Mon_Thu	medium	medium	1.00	high
20	Mon_Thu	high	low	1.00	medium
21	Mon_Thu	high	medium	0.50	very_high
22	Mon_Thu	medium	very_low	1.00	medium
23	Mon_Thu	high	low	1.00	high
24	Fri	high	medium	1.00	medium
25	Fri	high	low	1.00	medium
26	Fri	medium	low	1.00	medium
27	Fri	medium	very_low	1.00	medium
28					

Rule block number 11 for Fz2 (forecast result for 2300 hours)



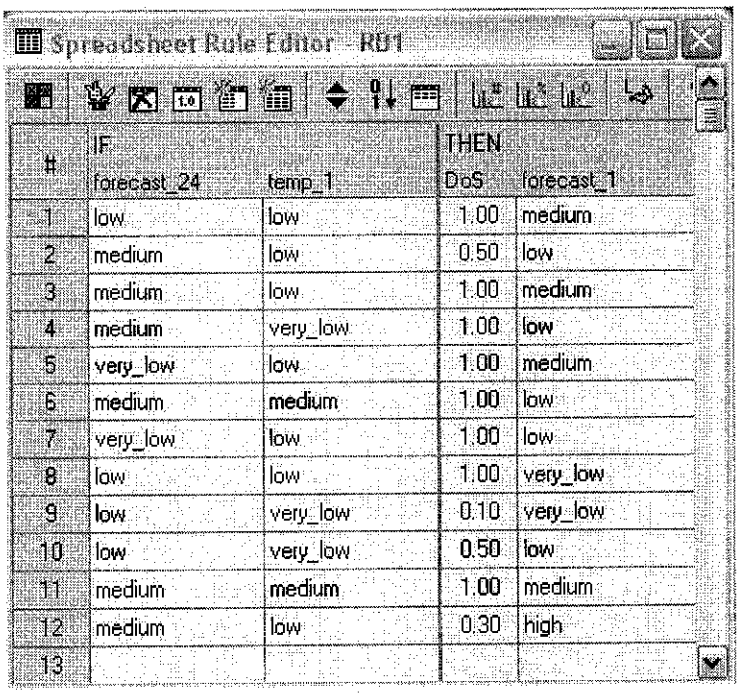
#	IF			THEN	
	day	forecast_22	temp_23	DoS	forecast_23
1	Sat	low	low	1.00	low
2	Sat	medium	low	1.00	medium
3	Sat	medium	medium	1.00	medium
4	Sat	medium	very_low	1.00	low
5	Sun	medium	low	1.00	low
6	Sun	medium	low	0.50	medium
7	Sun	low	low	1.00	low
8	Sun	low	very_low	1.00	low
9	Sun	low	very_low	1.00	medium
10	Mon_Thu	low	low	1.00	low
11	Mon_Thu	high	medium	1.00	medium
12	Mon_Thu	medium	medium	1.00	medium
13	Mon_Thu	medium	low	1.00	medium
14	Mon_Thu	high	low	1.00	medium
15	Mon_Thu	high	low	0.30	high
16	Mon_Thu	medium	very_low	1.00	medium
17	Mon_Thu	medium	very_low	1.00	low
18	Fri	medium	very_low	1.00	low
19	Fri	medium	low	1.00	medium
20	Fri	medium	medium	1.00	medium
21					

Rule block number 12 for Fz2 (forecast result for 0000 hours of the next day)



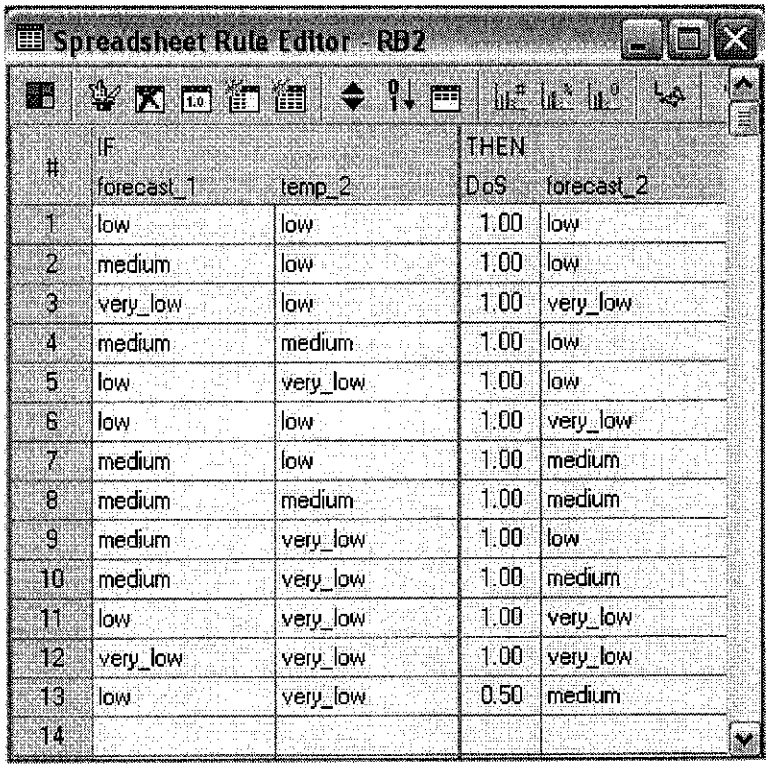
#	IF			THEN	
	day	forecast_23	temp_24	DoS	forecast_24
1	Sat	low	low	1.00	very_low
2	Sat	medium	low	1.00	low
3	Sat	medium	low	1.00	medium
4	Sat	medium	medium	1.00	medium
5	Sat	low	very_low	1.00	low
6	Sat	low	low	1.00	low
7	Sat	medium	very_low	1.00	low
8	Sat	medium	low	0.50	high
9	Sun	low	very_low	1.00	low
10	Sun	medium	low	1.00	low
11	Sun	low	low	1.00	low
12	Mon_Thu	low	low	1.00	low
13	Mon_Thu	medium	medium	1.00	medium
14	Mon_Thu	medium	low	1.00	medium
15	Mon_Thu	medium	low	1.00	low
16	Mon_Thu	medium	very_low	1.00	medium
17	Mon_Thu	medium	very_low	1.00	low
18	Mon_Thu	high	low	1.00	medium
19	Mon_Thu	medium	low	0.30	high
20	Fri	medium	low	1.00	medium
21	Fri	medium	low	1.00	low
22	Fri	medium	very_low	1.00	low
23					

Rule block number 13 for Fz2 (forecast result for 0100 hours of the next day)



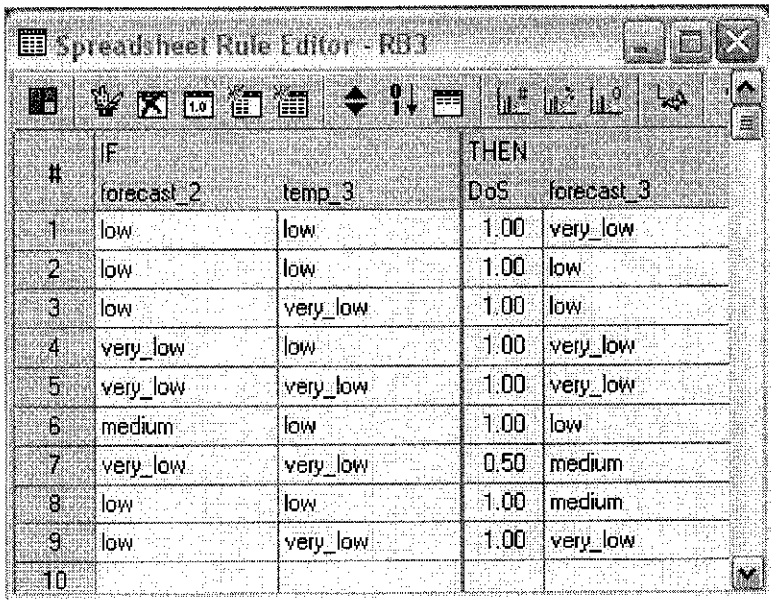
#	IF		THEN	
	forecast_24	temp_1	DoS	forecast_1
1	low	low	1.00	medium
2	medium	low	0.50	low
3	medium	low	1.00	medium
4	medium	very_low	1.00	low
5	very_low	low	1.00	medium
6	medium	medium	1.00	low
7	very_low	low	1.00	low
8	low	low	1.00	very_low
9	low	very_low	0.10	very_low
10	low	very_low	0.50	low
11	medium	medium	1.00	medium
12	medium	low	0.30	high
13				

Rule block number 14 for Fz2 (forecast result for 0200 hours of the next day)



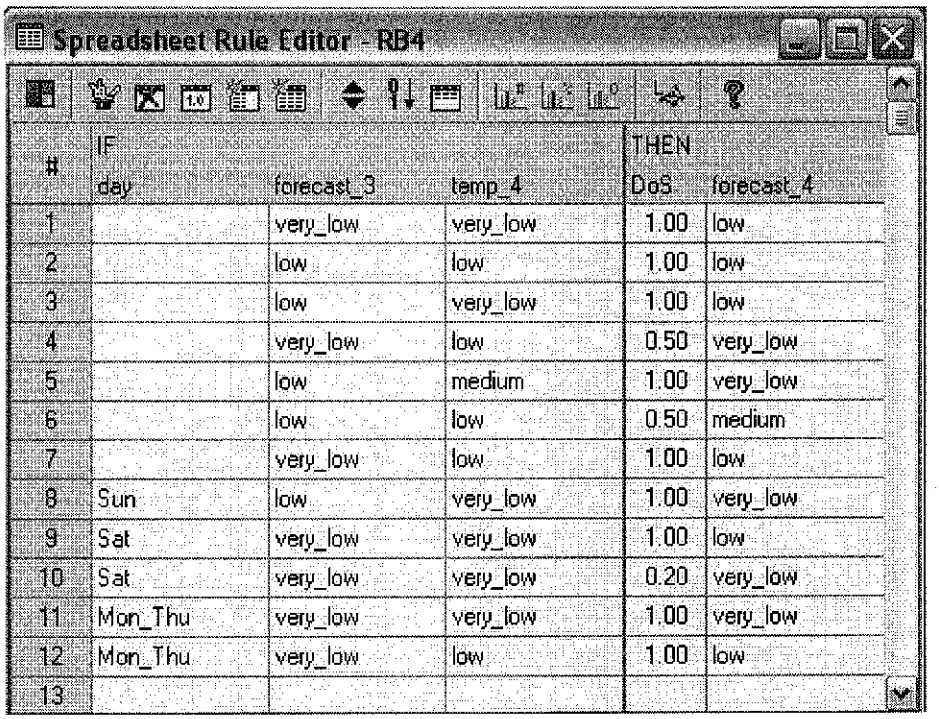
#	IF forecast_1	temp_2	THEN DoS	forecast_2
1	low	low	1.00	low
2	medium	low	1.00	low
3	very_low	low	1.00	very_low
4	medium	medium	1.00	low
5	low	very_low	1.00	low
6	low	low	1.00	very_low
7	medium	low	1.00	medium
8	medium	medium	1.00	medium
9	medium	very_low	1.00	low
10	medium	very_low	1.00	medium
11	low	very_low	1.00	very_low
12	very_low	very_low	1.00	very_low
13	low	very_low	0.50	medium
14				

Rule block number 15 for Fz2 (forecast result for 0300 hours of the next day)



#	IF forecast_2	temp_3	THEN DoS	forecast_3
1	low	low	1.00	very_low
2	low	low	1.00	low
3	low	very_low	1.00	low
4	very_low	low	1.00	very_low
5	very_low	very_low	1.00	very_low
6	medium	low	1.00	low
7	very_low	very_low	0.50	medium
8	low	low	1.00	medium
9	low	very_low	1.00	very_low
10				

Rule block number 16 for Fz2 (forecast result for 0400 hours of the next day)



#	IF day	forecast_3	temp_4	THEN DoS	forecast_4
1		very_low	very_low	1.00	low
2		low	low	1.00	low
3		low	very_low	1.00	low
4		very_low	low	0.50	very_low
5		low	medium	1.00	very_low
6		low	low	0.50	medium
7		very_low	low	1.00	low
8	Sun	low	very_low	1.00	very_low
9	Sat	very_low	very_low	1.00	low
10	Sat	very_low	very_low	0.20	very_low
11	Mon_Thu	very_low	very_low	1.00	very_low
12	Mon_Thu	very_low	low	1.00	low
13					

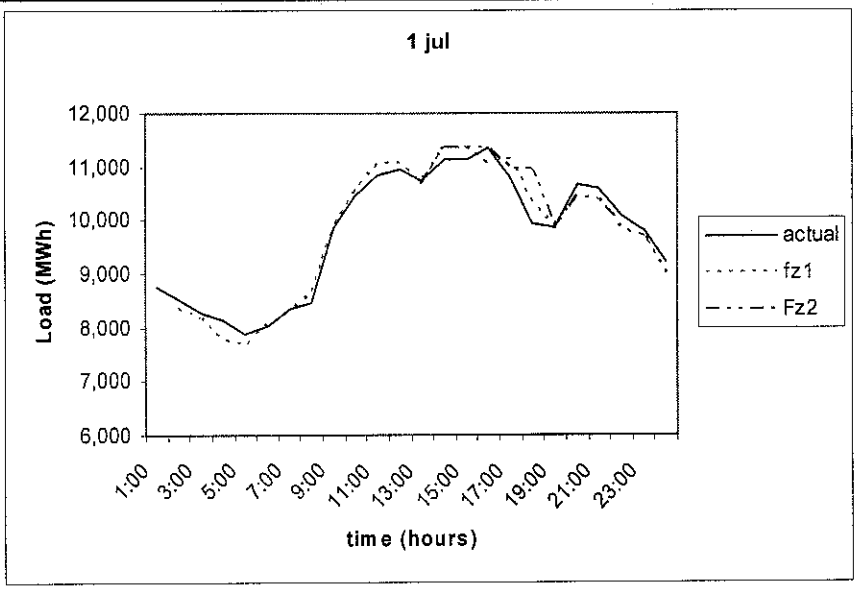
Rule block number 17 for Fz2 (forecast result for 0500 hours of the next day)

APPENDIX C

RESULT OF FORECAST DATA (19 AND 17 HOURS AHEAD LOAD FORECAST)

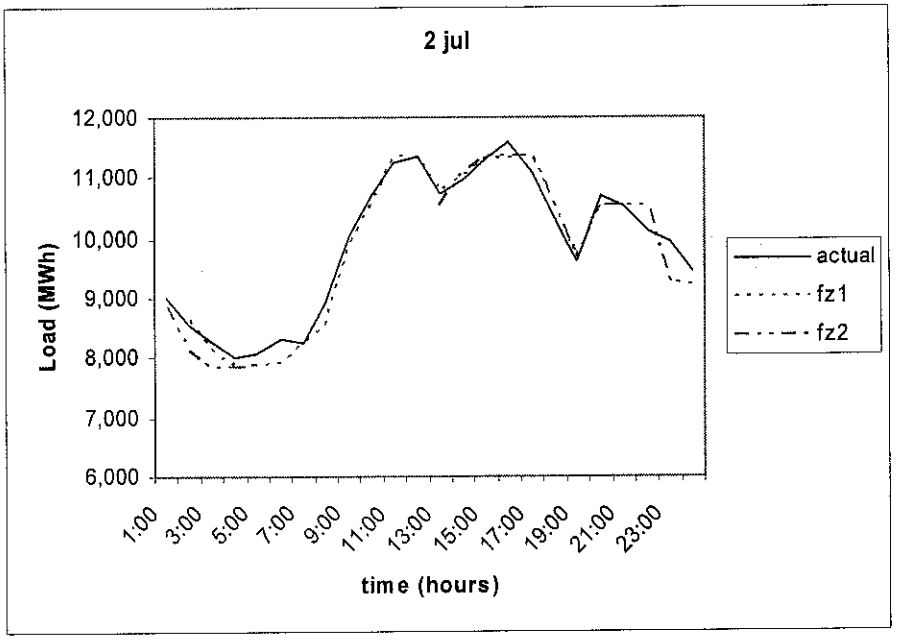
Result of forecast (19 and 17 hours ahead load forecast) data for 1st July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Thursday	1-Jul-04	1:00	24.9	8,738			100.00	
		2:00	24.8	8,513	8355.5		1.85	
	Fz1 % err							
	1.77	3:00	24.7	8,278	8158.8		1.44	
		4:00	24.8	8,126	7766.3		4.43	
		5:00	25.0	7,879	7645.6		2.96	
	Fz2 % err							
	2.27	6:00	24.8	8,029	8073.8		0.56	
		7:00	25.1	8,343	8323.7		0.23	
		8:00	26.7	8,457	8595.2		1.63	
		9:00	28.5	9,878	9888.4		0.11	
		10:00	29.1	10,434	10530.3		0.92	
		11:00	30.9	10,853	11075		2.05	
		12:00	32.2	10,953	11077.6		1.14	
		13:00	33.0	10,729	10698.9	10677.4	0.28	0.48
		14:00	32.2	11,132	11350.9	11351.9	1.97	1.98
		15:00	32.1	11,146	11350.9	11351.9	1.84	1.85
		16:00	33.0	11,334	11063.8	11351.9	2.38	0.16
		17:00	31.7	10,766	11118.4	10967.7	3.27	1.87
		18:00	30.3	9,931	10338.3	10967.7	4.10	10.44
		19:00	29.0	9,876	9825.9	9911.6	0.51	0.36
		20:00	28.3	10,666	10448.7	10448.9	2.04	2.04
		21:00	28.1	10,587		10362.1		2.12
		22:00	27.4	10,084		9840.9		2.41
		23:00	27.0	9,807		9682.8		1.27
		0:00	26.8	9,199		8991.5		2.26



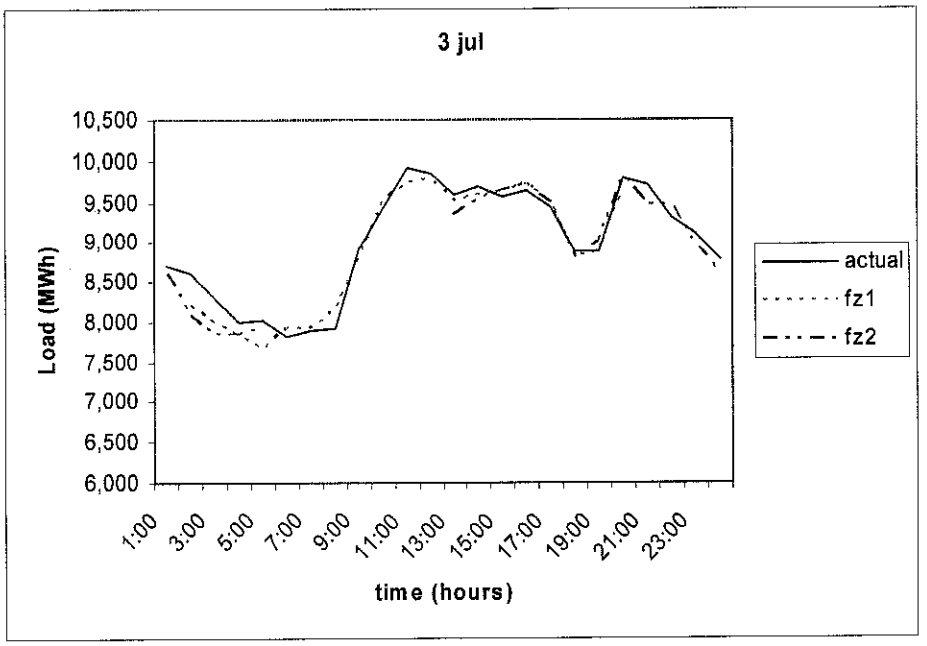
Result of forecast (19 and 17 hours ahead load forecast) data for 2nd July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
	2-Jul-							
Friday	04	1:00	27.1	8,988		8852		1.51
		2:00	26.9	8,569	8672.5	8109.7	1.21	5.36
	Fz1 % err	3:00	26.5	8,292	8145	7841.6	1.77	5.43
	1.68	4:00	26.3	8,022	7841.6	7841.6	2.25	2.25
		5:00	26.2	8,079	7868.7	7868.7	2.60	2.60
	Fz2 % err	6:00	26.1	8,322	7894.8		5.13	
	2.52	7:00	25.0	8,245	8248.5		0.04	
		8:00	26.5	8,942	8545.8		4.43	
		9:00	28.5	10,073	9878.9		1.93	
		10:00	31.2	10,691	10517.4		1.62	
		11:00	32.6	11,235	11337.8		0.91	
		12:00	33.9	11,352	11334.4		0.16	
		13:00	34.6	10,732	10787.1	10550	0.51	1.70
		14:00	34.8	10,979	11058.1	11091.6	0.72	1.03
		15:00	35.7	11,335	11334.4	11362.5	0.01	0.24
		16:00	35.5	11,600	11334.4	11362.5	2.29	2.05
		17:00	35.1	11,090	11345.1	11362.5	2.30	2.46
		18:00	32.1	10,331	10523.6	10550	1.86	2.12
		19:00	30.3	9,605	9671.6	9683.3	0.69	0.82
		20:00	29.5	10,700	10535.6	10550	1.54	1.40
		21:00	29.2	10,520		10550		0.29
		22:00	29.0	10,113		10550		4.32
		23:00	28.7	9,942		9250		6.96
		0:00	28.0	9,433		9218.8		2.27



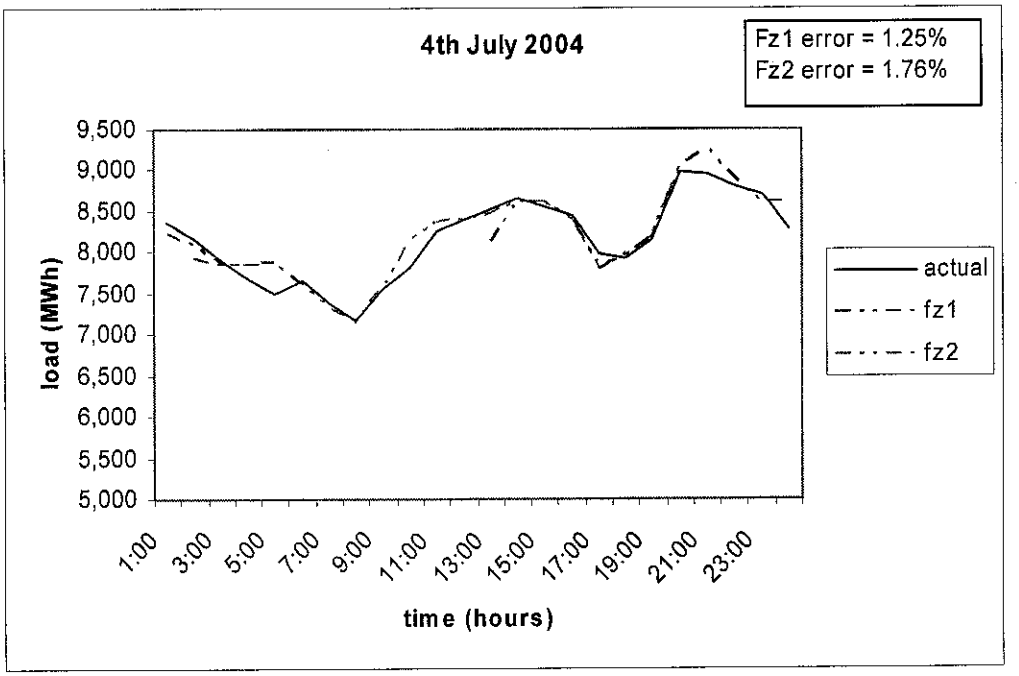
Result of forecast (19 and 17 hours ahead load forecast) data for 3rd July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Saturday	3-Jul-04	1:00	27.2	8,700		8600		1.15
		2:00	26.8	8,611	8210.9	8085.3	4.65	6.10
	Fz1 % err	3:00	26.0	8,293	7989.5	7841.6	3.66	5.44
	1.59	4:00	24.0	7,999	7841.6	7841.6	1.97	1.97
		5:00	23.6	8,025	7675.8	7911	4.35	1.42
	Fz2 % err	6:00	23.7	7,817	7928.6		1.43	
	1.95	7:00	24.0	7,907	7928.6		0.27	
		8:00	24.8	7,914	8149.1		2.97	
		9:00	25.9	8,941	8794.8		1.64	
		10:00	27.1	9,429	9515.7		0.92	
		11:00	27.9	9,915	9741.2		1.75	
		12:00	29.5	9,832	9755.2		0.78	
		13:00	30.5	9,600	9523.7	9332.7	0.79	2.78
		14:00	30.5	9,693	9600.6	9534.3	0.95	1.64
		15:00	30.5	9,571	9636	9636	0.68	0.68
		16:00	30.2	9,629	9720.4	9720.2	0.95	0.95
		17:00	29.7	9,445	9476.6	9476.6	0.33	0.33
		18:00	29.2	8,888	8816.8	8816.7	0.80	0.80
		19:00	28.5	8,877	8871.6	9013.8	0.06	1.54
		20:00	27.8	9,794	9670.7	9819	1.26	0.26
		21:00	27.5	9,721		9476		2.52
		22:00	27.0	9,309		9475.9		1.79
		23:00	26.5	9,117		8952.4		1.81
		0:00	26.2	8,772		8600		1.96



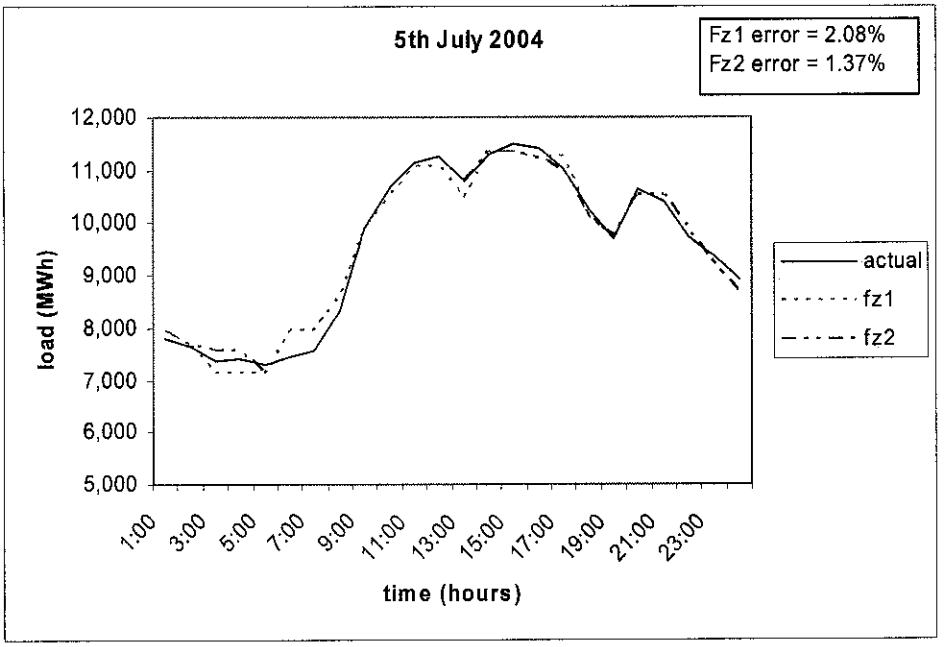
Result of forecast (19 and 17 hours ahead load forecast) data for 4th July 2004

	date	time	temp.	actual load	Fz1	Fz2	err Fz1	err Fz2
Sunday	4-Jul-04	1:00	26.4	8,365		8228.6		1.63
		2:00	26.2	8,169	7916.7	8085.5	3.09	1.02
	Fz1 % err	3:00	26.2	7,894	7841.6	7841.6	0.66	0.66
	1.25	4:00	26.0	7,677	7841.6	7841.6	2.14	2.14
		5:00	25.7	7,500	7868.7	7868.7	4.92	4.92
	Fz2 % err	6:00	25.5	7,650	7594.8		0.72	
	1.76	7:00	25.3	7,387	7322.9		0.87	
		8:00	26.4	7,156	7137.5		0.26	
		9:00	28.3	7,556	7560		0.05	
		10:00	29.9	7,832	8141.3		3.95	
		11:00	31.3	8,257	8350.9		1.14	
		12:00	32.3	8,387	8383.3		0.04	
		13:00	32.6	8,533	8481.8	8106.8	0.60	4.99
		14:00	33.4	8,673	8600	8600	0.84	0.84
		15:00	31.9	8,562	8600	8600	0.44	0.44
		16:00	26.2	8,440	8383.4	8383.4	0.67	0.67
		17:00	25.3	7,988	7803.8	7803.8	2.31	2.31
		18:00	25.4	7,929	7950	7950	0.26	0.26
		19:00	24.6	8,147	8169.3	8169.3	0.27	0.27
		20:00	24.0	8,991	9030.7	9030.7	0.44	0.44
		21:00	24.6	8,962		9250		3.21
		22:00	24.2	8,810		8903.3		1.06
		23:00	24.1	8,706		8600		1.22
		0:00	23.7	8,285		8600		3.80



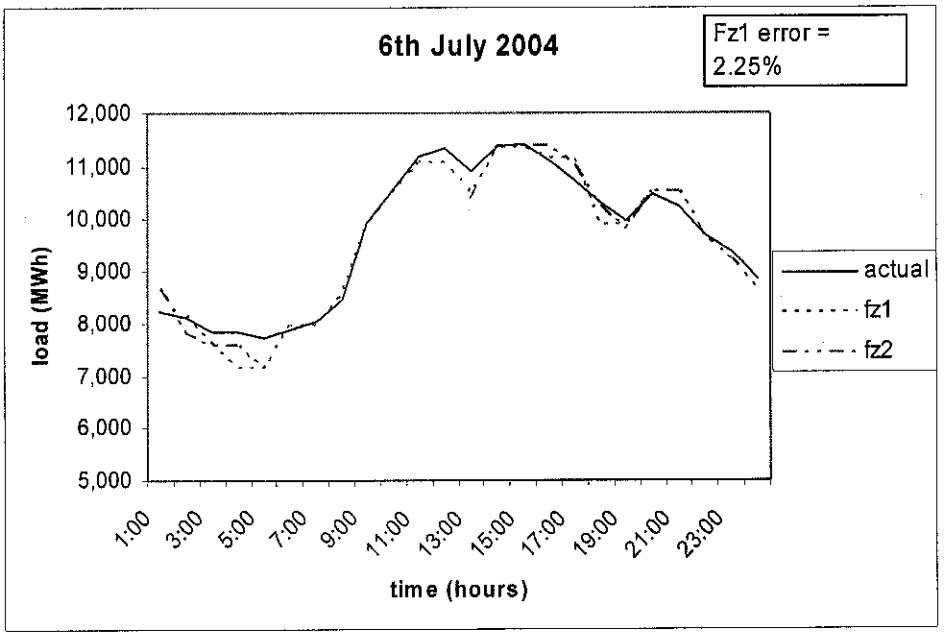
Result of forecast (19 and 17 hours ahead load forecast) data for 5th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Monday	5-Jul-04	1:00	23.7	7,804		7950		1.87
		2:00	23.6	7,626	7675.7	7675.8	0.65	0.65
	Fz1 % err	3:00	23.5	7,374	7137.5	7559.8	3.21	2.52
	2.08	4:00	23.4	7,409	7137.5	7559.8	3.66	2.04
		5:00	23.4	7,307	7137.5	7137.5	2.32	2.32
	Fz2 % err	6:00	23.4	7,466	7940.6		6.36	
	1.37	7:00	23.9	7,580	7948.2		4.86	
		8:00	26.1	8,363	8593.5		2.76	
		9:00	27.6	9,909	9884.1		0.25	
		10:00	29.0	10,678	10523.2		1.45	
		11:00	30.1	11,149	11069.1		0.72	
		12:00	30.9	11,278	11072.4		1.82	
		13:00	32.1	10,803	10473.2	10801.8	3.05	0.01
		14:00	31.7	11,317	11346.6	11346.7	0.26	0.26
		15:00	26.4	11,507	11346.6	11346.7	1.39	1.39
		16:00	25.7	11,426	11221	11221.2	1.79	1.79
		17:00	24.4	11,047	11267.2	10981.1	1.99	0.60
		18:00	24.9	10,242	10108.4	10108.5	1.30	1.30
		19:00	25.1	9,705	9759.3	9757.6	0.56	0.54
		20:00	25.3	10,640	10527.7	10527.8	1.06	1.05
		21:00	25.2	10,398		10504.1		1.02
		22:00	25.1	9,744		9872		1.31
		23:00	24.4	9,413		9250		1.73
		0:00	24.4	8,909		8652.5		2.88



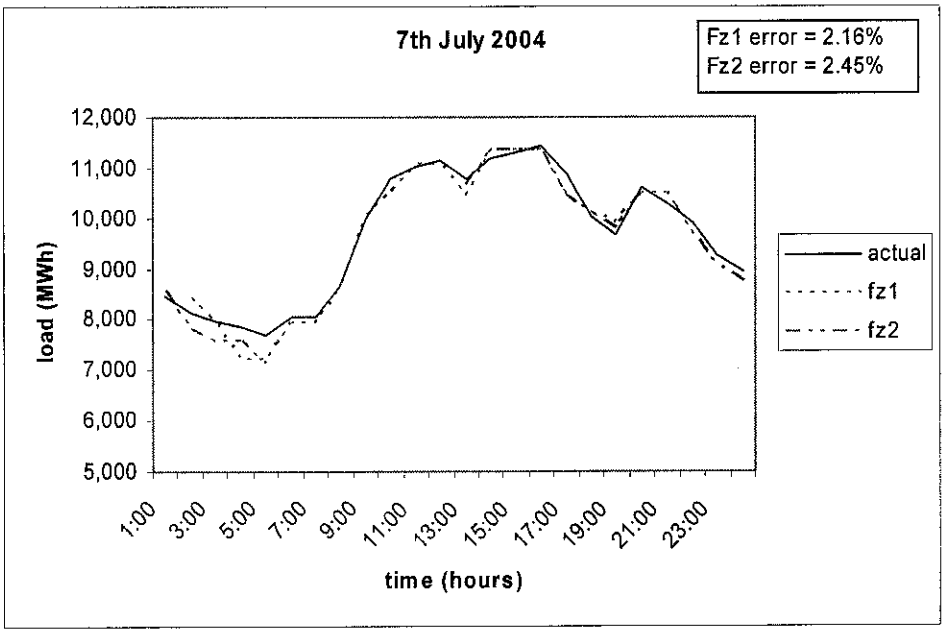
Result of forecast (19 and 17 hours ahead load forecast) data for 6th July 2004

date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
6-Jul-							
Tuesday 04	1:00	24.0	8,228		8652.5		5.16
	2:00	24.0	8,117	8165.8	7800.3	0.60	3.90
Fz1 % err	3:00	24.0	7,845	7589.1	7559.9	3.26	3.63
2.25	4:00	23.8	7,847	7137.5	7559.9	9.04	3.66
	5:00	23.7	7,717	7137.5	7137.5	7.51	7.51
Fz2 % err	6:00	23.5	7,860	7939.4		1.01	
2.57	7:00	24.5	8,041	7947.9		1.16	
	8:00	26.8	8,475	8592.6		1.39	
	9:00	27.9	9,952	9882.1		0.70	
	10:00	28.9	10,549	10519.7		0.28	
	11:00	30.3	11,180	11066.3		1.02	
	12:00	30.1	11,331	11070.2		2.30	
	13:00	30.9	10,916	10472.2	10424.8	4.07	4.50
	14:00	28.6	11,377	11344.6	11362.5	0.28	0.13
	15:00	27.8	11,409	11350.1	11362.5	0.52	0.41
	16:00	30.1	11,089	11158.2	11362.5	0.62	2.47
	17:00	30.5	10,775	11158.2	11039	3.56	2.45
	18:00	25.9	10,318	9908.7	10247.4	3.97	0.68
	19:00	25.2	9,988	9893.7	9835.7	0.94	1.52
	20:00	24.3	10,473	10524.9	10530.2	0.50	0.55
	21:00	24.3	10,249		10509		2.54
	22:00	23.7	9,719		9683.3		0.37
	23:00	23.8	9,383		9243.4		1.49
	0:00	24.0	8,845		8600		2.77



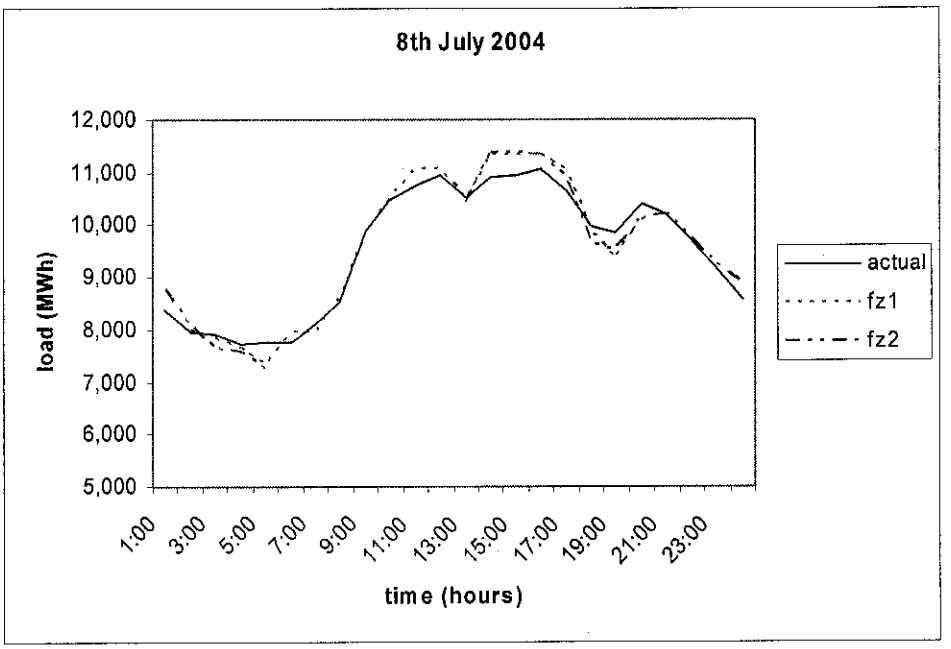
Result of forecast (19 and 17 hours ahead load forecast) data for 7th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Wednesday	7-Jul-04	1:00	23.0	8,440		8600		1.90
		2:00	22.6	8,138	8465.1	7800.5	4.02	4.15
	Fz1 % err	3:00	23.0	7,990	7934.7	7559.9	0.69	5.38
	2.16	4:00	23.5	7,849	7214.6	7559.9	8.08	3.68
		5:00	23.4	7,689	7214.6	7137.5	6.17	7.17
	Fz2 % err	6:00	23.5	8,047	7939		1.34	
	2.45	7:00	23.5	8,070	7947.9		1.51	
		8:00	24.7	8,648	8592.3		0.64	
		9:00	26.0	9,977	10061.7		0.85	
		10:00	28.6	10,791	10518.5		2.53	
		11:00	29.9	11,020	11065.1		0.41	
		12:00	30.6	11,173	11069.1		0.93	
		13:00	31.9	10,782	10471.6	10673.5	2.88	1.01
		14:00	30.5	11,204	11343.8	11349	1.25	1.29
		15:00	30.0	11,307	11343.8	11349	0.33	0.37
		16:00	24.2	11,452	11343.8	11349	0.94	0.90
		17:00	25.0	10,888	10423.1	10425	4.27	4.25
		18:00	25.1	10,029	10107	10109.6	0.78	0.80
		19:00	25.1	9,685	9891.7	9788.9	2.13	1.07
		20:00	25.1	10,651	10523.9	10531	1.19	1.13
		21:00	24.8	10,315		10510.6		1.90
		22:00	25.2	9,906		9677.6		2.31
		23:00	24.8	9,265		9080.4		1.99
		0:00	25.0	8,937		8729.7		2.32



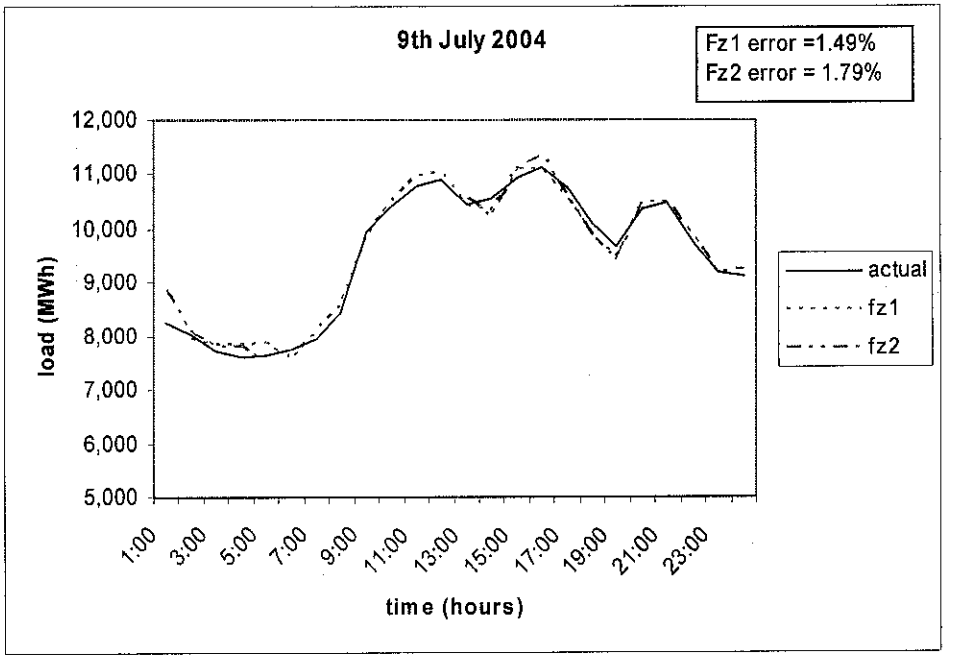
Result of forecast (19 and 17 hours ahead load forecast) data for 8th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Thursday	8-Jul-04	1:00	25.0	8,379		8769.1		4.66
		2:00	24.8	7,963	8011.8	8065.7	0.61	1.29
	Fz1 % err	3:00	24.7	7,925	7841.6	7649.6	1.05	3.48
	2.16	4:00	24.5	7,724	7640.4	7560	1.08	2.12
		5:00	24.3	7,763	7318.6	7257.1	5.72	6.52
	Fz2 % err	6:00	23.9	7,758	7969.7		2.73	
	2.68	7:00	23.8	8,127	7947.6		2.21	
		8:00	25.8	8,533	8591.3		0.68	
		9:00	27.7	9,891	9878.9		0.12	
		10:00	28.7	10,470	10514.4		0.42	
		11:00	29.6	10,743	11061.7		2.97	
		12:00	30.8	10,942	11066.3		1.14	
		13:00	31.2	10,507	10470.5	10446.5	0.35	0.58
		14:00	32.0	10,895	11341.3	11358.6	4.10	4.26
		15:00	32.5	10,962	11341.3	11358.6	3.46	3.62
		16:00	30.8	11,064	11341.3	11357.5	2.51	2.65
		17:00	29.3	10,633	11026.9	10863.9	3.70	2.17
		18:00	29.2	9,975	9892.6	9667.8	0.83	3.08
		19:00	28.0	9,873	9344.5	9513.4	5.35	3.64
		20:00	27.4	10,398	10188.3	10105	2.02	2.82
		21:00	26.9	10,199		10221.9		0.22
		22:00	26.2	9,715		9698.5		0.17
		23:00	25.9	9,147		9250		1.13
		0:00	25.4	8,583		8852		3.13



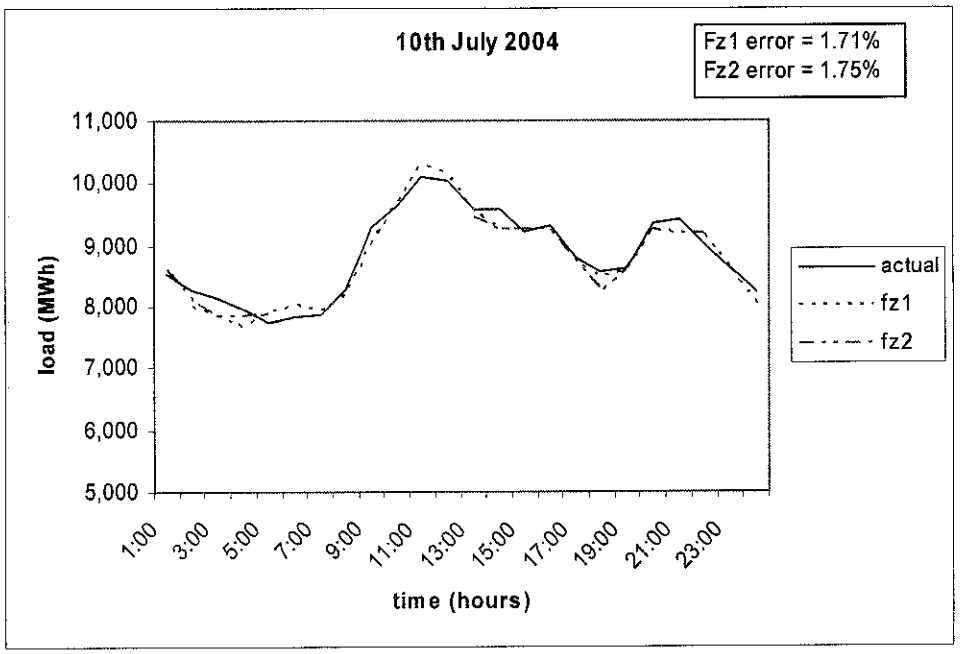
Result of forecast (19 and 17 hours ahead load forecast) data for 9th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
	9-Jul-							
Friday	04	1:00	25.3	8,271		8851.8		7.02
		2:00	25.5	8,024	7934.8	8081.8	1.11	0.72
	Fz1 % err							
	1.49	3:00	25.3	7,740	7841.6	7801.4	1.31	0.79
		4:00	25.3	7,608	7841.6	7801.4	3.07	2.54
		5:00	25.0	7,664	7868.7	7531.3	2.67	1.73
	Fz2 % err							
		6:00	24.8	7,747	7573.3		2.24	
	1.79	7:00	25.0	7,948	8089.4		1.78	
		8:00	26.9	8,441	8545.8		1.24	
		9:00	28.4	9,964	9869.5		0.95	
		10:00	28.7	10,416	10502.8		0.83	
		11:00	30.0	10,799	10981.5		1.69	
		12:00	30.2	10,915	11017.4		0.94	
		13:00	31.6	10,435	10462.4	10550	0.26	1.10
		14:00	31.4	10,544	10349.5	10225	1.84	3.03
		15:00	32.0	10,959	11091.4	11091.6	1.21	1.21
		16:00	31.0	11,114	11091.4	11362.5	0.20	2.24
		17:00	29.9	10,734	10550	10550	1.71	1.71
		18:00	29.2	10,098	9900	9900	1.96	1.96
		19:00	28.9	9,705	9491.5	9435.6	2.20	2.78
		20:00	28.4	10,375	10478.9	10497.7	1.00	1.18
		21:00	27.6	10,481		10497.7		0.16
		22:00	26.8	9,779		9880.2		1.03
		23:00	26.6	9,216		9218.3		0.02
		0:00	26.3	9,114		9223.9		1.21



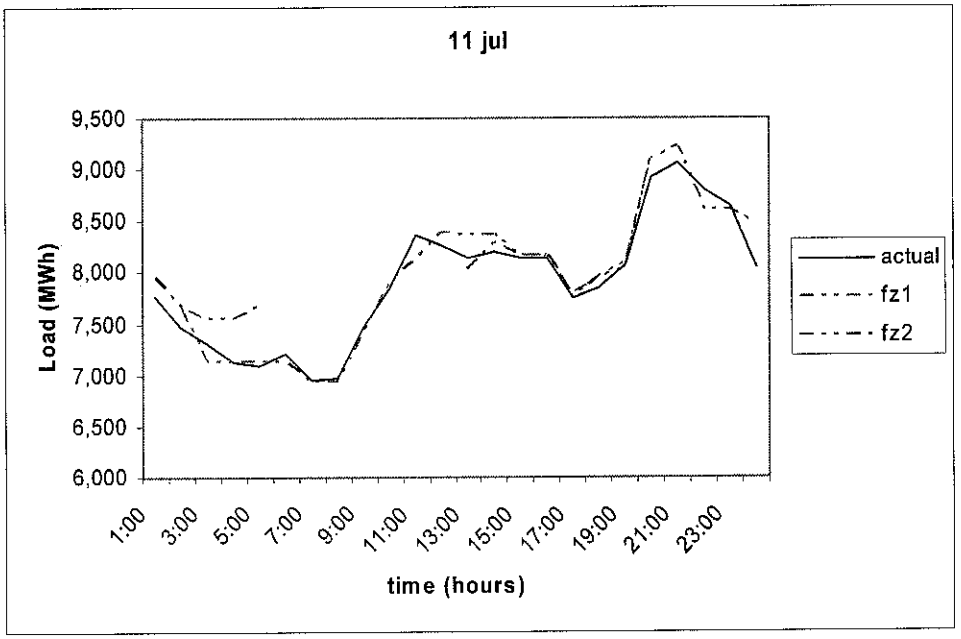
Result of forecast (19 and 17 hours ahead load forecast) data for 10th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Saturday	10-Jul-04	1:00	26.1	8,519		8600		0.95
		2:00	25.7	8,277	7983.8	8092.5	3.54	2.23
	Fz1 % err	3:00	25.1	8,144	7841.6	7841.6	3.71	3.71
	1.71	4:00	24.7	7,982	7665.7	7841.6	3.96	1.76
		5:00	24.8	7,744	7885.8	7876.2	1.83	1.71
	Fz2 % err	6:00	24.5	7,834	8036.2		2.58	
	1.75	7:00	24.9	7,870	7928		0.74	
		8:00	26.1	8,280	8148.6		1.59	
		9:00	27.5	9,293	9015.8		2.98	
		10:00	28.8	9,637	9695.2		0.60	
		11:00	25.5	10,106	10295.9		1.88	
		12:00	27.7	10,050	10136.5		0.86	
		13:00	26.3	9,590	9564.8	9436.3	0.26	1.60
		14:00	26.5	9,566	9250	9250	3.30	3.30
		15:00	26.5	9,225	9250	9250	0.27	0.27
		16:00	26.5	9,331	9250	9250	0.87	0.87
		17:00	26.9	8,775	8713.4	8713.3	0.70	0.70
		18:00	26.3	8,564	8453.4	8228.5	1.29	3.92
		19:00	25.8	8,634	8600	8600	0.39	0.39
		20:00	25.3	9,363	9250	9250	1.21	1.21
		21:00	25.0	9,406		9174.6		2.46
		22:00	24.6	9,025		9174.6		1.66
		23:00	24.1	8,634		8600		0.39
		0:00	24.2	8,236		8025.4		2.56



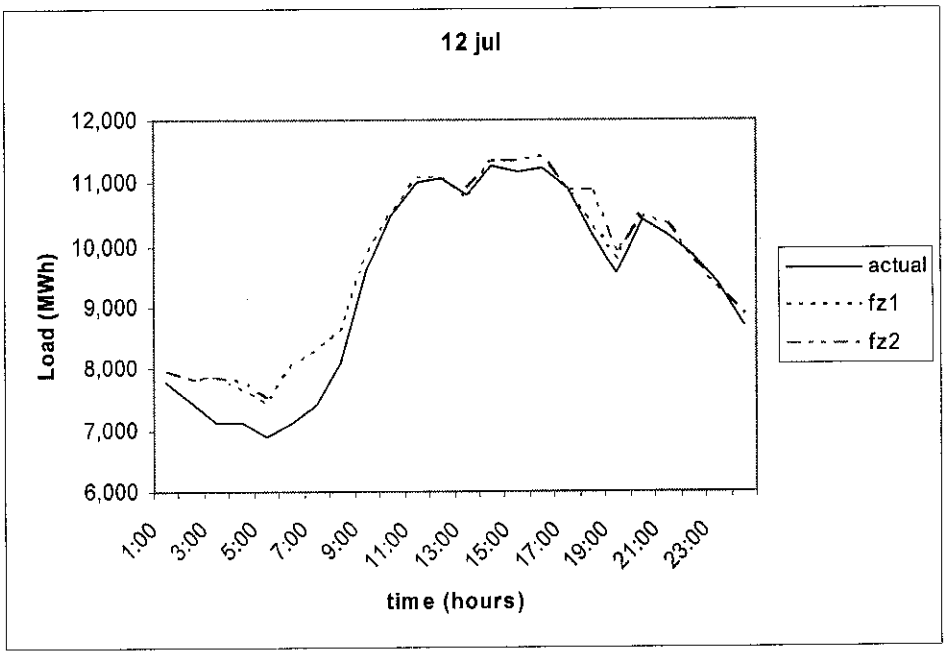
Result of forecast (19 and 17 hours ahead load forecast) data for 11th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Sunday	11-Jul-04	1:00	24.0	7,777		7950		2.22
		2:00	23.8	7,465	7675.7	7677.4	2.82	2.85
	Fz1 % err	3:00	23.7	7,306	7137.5	7559.4	2.31	3.47
	1.18	4:00	23.4	7,140	7137.5	7559.4	0.04	5.87
		5:00	23.2	7,098	7137.5	7677.4	0.56	8.16
	Fz2 % err	6:00	23.0	7,221	7137.5		1.16	
	2.32	7:00	23.4	6,948	6935.3		0.18	
		8:00	25.3	6,973	6935.3		0.54	
		9:00	27.9	7,471	7413.5		0.77	
		10:00	29.5	7,849	7910.9		0.79	
		11:00	30.8	8,376	8125		3.00	
		12:00	30.0	8,260	8383.4		1.49	
		13:00	29.7	8,142	8372	8026.2	2.82	1.42
		14:00	28.8	8,212	8372	8292	1.95	0.97
		15:00	25.8	8,150	8169.4	8169.3	0.24	0.24
		16:00	26.1	8,147	8169.4	8169.3	0.27	0.27
		17:00	27.6	7,746	7747.3	7794.4	0.02	0.62
		18:00	28.4	7,846	7950	7950	1.33	1.33
		19:00	27.5	8,066	8086.3	8054.1	0.25	0.15
		20:00	27.0	8,918	9094.9	9094.9	1.98	1.98
		21:00	26.8	9,072		9231.1		1.75
		22:00	26.5	8,810		8600		2.38
		23:00	26.0	8,639		8600		0.45
		0:00	25.8	8,049		8470.1		5.23



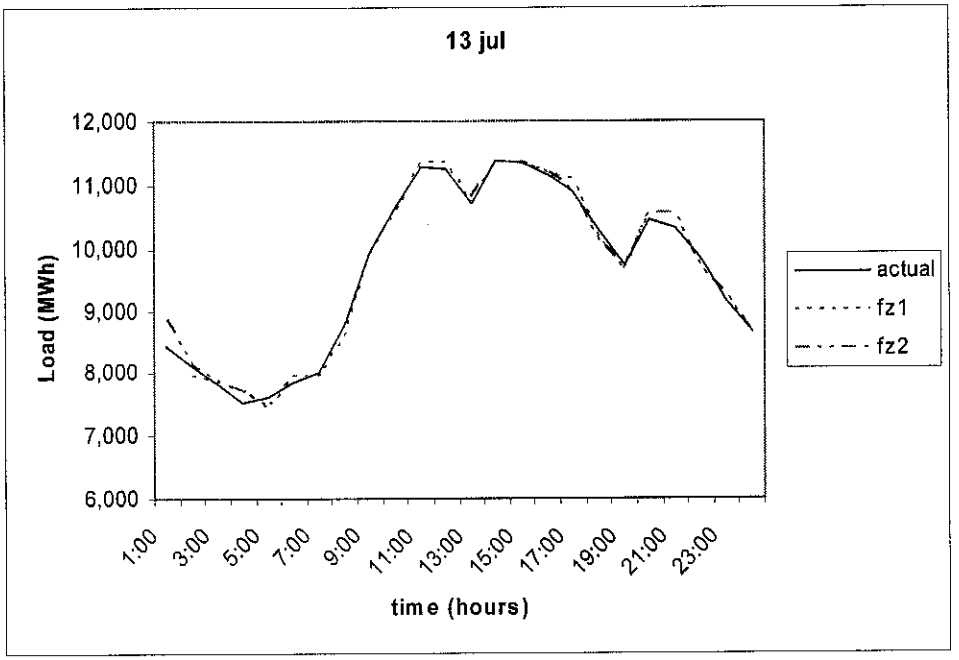
Result of forecast (19 and 17 hours ahead load forecast) data for 12th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
	12-Jul-							
Monday	04	1:00	25.5	7,792		7950		2.03
		2:00	25.5	7,456	7815.9	7820	4.83	4.88
	Fz1 % err	3:00	25.0	7,116	7841.6	7841.6	10.20	10.20
	3.93	4:00	25.0	7,132	7634.4	7787.5	7.04	9.19
		5:00	24.9	6,888	7419.1	7521.6	7.71	9.20
	Fz2 % err	6:00	24.7	7,125	8070.7		13.27	
	3.33	7:00	24.8	7,405	8304.2		12.14	
		8:00	26.2	8,125	8594.6		5.78	
		9:00	28.4	9,640	9887		2.56	
		10:00	29.5	10,488	10527.9		0.38	
		11:00	31.3	11,018	11073.1		0.50	
		12:00	32.7	11,080	11075.9		0.04	
		13:00	33.1	10,816	10746.5	10925.6	0.64	1.01
		14:00	33.3	11,287	11349.5	11349.5	0.55	0.55
		15:00	32.7	11,179	11349.5	11349.5	1.53	1.53
		16:00	31.7	11,254	11415.7	11415.7	1.44	1.44
		17:00	31.7	10,919	10863.9	10863.9	0.50	0.50
		18:00	30.3	10,173	10321.2	10863.9	1.46	6.79
		19:00	28.3	9,554	9806.4	9877	2.64	3.38
		20:00	27.7	10,425	10580.3	10440.9	1.49	0.15
		21:00	27.0	10,182		10345.7		1.61
		22:00	26.7	9,858		9756.7		1.03
		23:00	26.1	9,403		9286.4		1.24
		0:00	25.9	8,692		8852		1.84



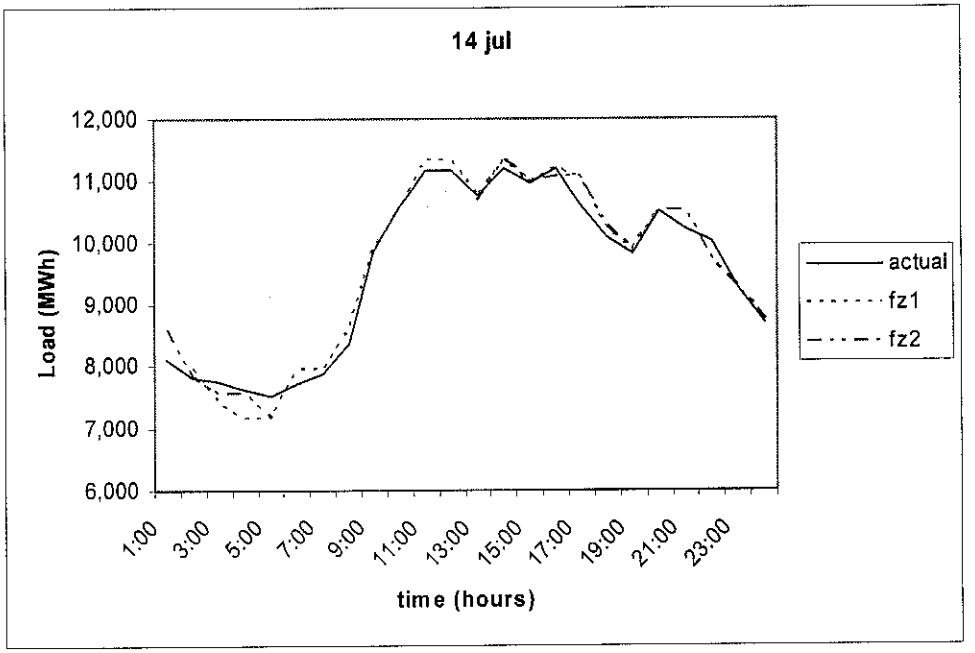
Result of forecast (19 and 17 hours ahead load forecast) data for 13th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Tuesday	13-Jul-04	1:00	25.8	8,419		8852		5.14
		2:00	25.3	8,121	7938.7	8103.4	2.24	0.22
	Fz1 % err	3:00	25.2	7,824	7841.6	7841.6	0.22	0.22
	1.08	4:00	25.0	7,532	7724.3	7724.3	2.55	2.55
		5:00	24.2	7,623	7419.1	7419.1	2.67	2.67
	Fz2 % err	6:00	24.1	7,854	7942.3		1.12	
	1.25	7:00	24.4	8,019	7948.5		0.88	
		8:00	27.0	8,790	8594.6		2.22	
		9:00	29.2	9,936	9887		0.49	
		10:00	30.9	10,628	10533.7		0.89	
		11:00	30.4	11,276	11349.5		0.65	
		12:00	30.7	11,264	11349.5		0.76	
		13:00	30.3	10,698	10698.1	10785	0.00	0.81
		14:00	28.8	11,396	11349.5	11356.5	0.41	0.35
		15:00	25.2	11,346	11353.4	11362.5	0.07	0.15
		16:00	25.1	11,153	11202.3	11181.3	0.44	0.25
		17:00	25.5	10,910	11091.7	10894.8	1.67	0.14
		18:00	23.4	10,273	10156.2	10108.6	1.14	1.60
		19:00	23.2	9,735	9636.5	9683.3	1.01	0.53
		20:00	23.3	10,438	10550	10550	1.07	1.07
		21:00	23.4	10,326		10550		2.17
		22:00	23.5	9,848		9683.3		1.67
		23:00	23.6	9,131		9242.6		1.22
		0:00	23.7	8,645		8600		0.52



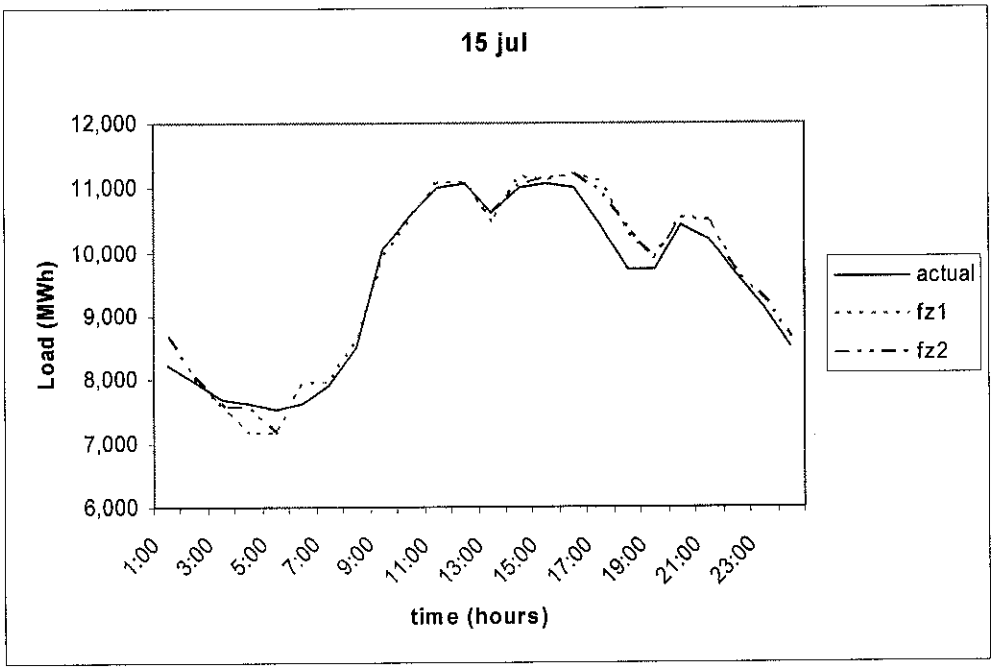
Result of forecast (19 and 17 hours ahead load forecast) data for 14th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Wednesday	14-Jul-04	1:00	23.8	8,108		8600		6.07
		2:00	23.9	7,825	7970.2	7800.2	1.86	0.32
	Fz1 % err	3:00	24.0	7,759	7394.1	7559.9	4.70	2.57
	1.87	4:00	24.2	7,626	7137.5	7559.9	6.41	0.87
		5:00	23.9	7,512	7137.5	7137.5	4.99	4.99
	Fz2 % err	6:00	23.5	7,707	7940.5		3.03	
	1.86	7:00	24.0	7,889	7948.2		0.75	
		8:00	26.5	8,388	8593.4		2.45	
		9:00	28.6	9,864	9883.9		0.20	
		10:00	30.5	10,581	10522.9		0.55	
		11:00	31.5	11,190	11343.6		1.37	
		12:00	32.0	11,180	11346.4		1.49	
		13:00	31.7	10,796	10748.4	10693.4	0.44	0.95
		14:00	25.0	11,198	11346.4	11348.8	1.33	1.35
		15:00	25.2	10,983	10981.6	11004.2	0.01	0.19
		16:00	25.7	11,219	11211.5	11083.4	0.07	1.21
		17:00	25.9	10,630	11046.5	11085.7	3.92	4.29
		18:00	25.2	10,072	10216.2	10254.5	1.43	1.81
		19:00	25.1	9,835	9877.1	9826	0.43	0.09
		20:00	25.1	10,523	10527.5	10530.8	0.04	0.07
		21:00	24.7	10,220		10510.2		2.84
		22:00	24.8	10,037		9677.6		3.58
		23:00	24.8	9,272		9250		0.24
		0:00	24.6	8,715		8731		0.18



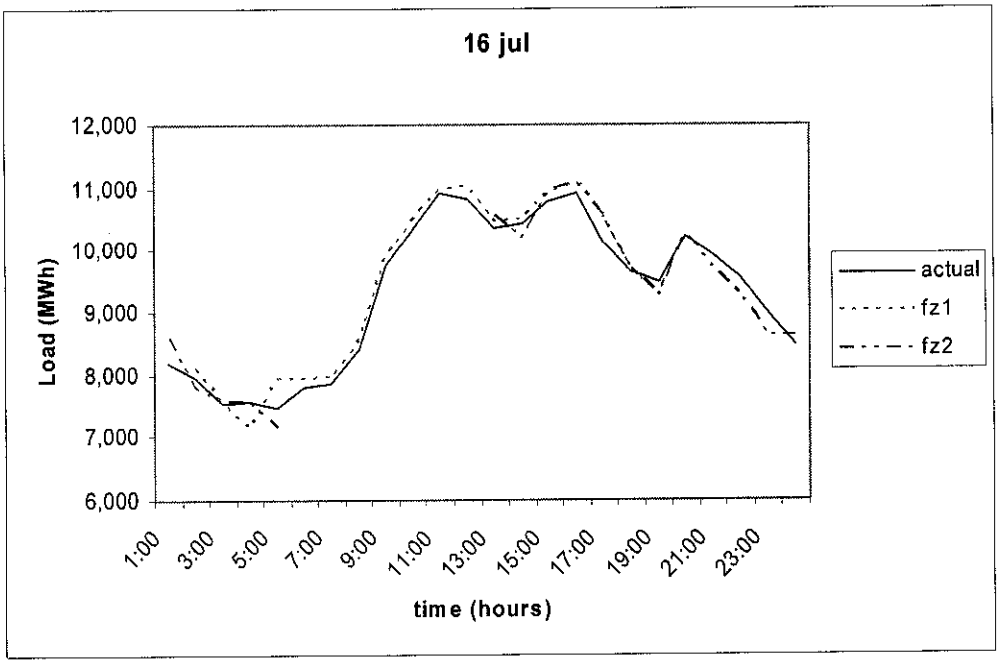
Result of forecast (19 and 17 hours ahead load forecast) data for 15th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Thursday	15-Jul-04	1:00	24.7	8,230		8689.3		5.58
		2:00	24.2	7,965	8009.9	8043.5	0.56	0.99
	Fz1 % err	3:00	23.8	7,691	7592.5	7560	1.28	1.70
	2.19	4:00	23.6	7,619	7137.5	7560	6.32	0.77
		5:00	23.1	7,525	7137.5	7137.5	5.15	5.15
	Fz2 % err	6:00	23.1	7,641	7939.4		3.91	
	2.19	7:00	23.4	7,909	7947.9		0.49	
		8:00	25.2	8,511	8592.6		0.96	
		9:00	27.6	10,063	9882		1.80	
		10:00	29.2	10,597	10519.7		0.73	
		11:00	30.2	11,026	11066.1		0.36	
		12:00	31.1	11,088	11070		0.16	
		13:00	26.0	10,635	10472.2	10581.8	1.53	0.50
		14:00	24.4	11,019	11182.5	11035.9	1.48	0.15
		15:00	23.8	11,069	11119.5	11143.8	0.46	0.68
		16:00	24.9	11,003	11197.7	11197.7	1.77	1.77
		17:00	26.1	10,434	11117.3	10961.4	6.55	5.05
		18:00	26.2	9,723	10265.3	10344.9	5.58	6.40
		19:00	25.7	9,719	9893.7	9895.7	1.80	1.82
		20:00	25.2	10,445	10524.9	10533.1	0.76	0.84
		21:00	24.7	10,197		10514.7		3.12
		22:00	24.5	9,676		9678.2		0.02
		23:00	24.4	9,131		9250		1.30
		0:00	24.3	8,518		8640.4		1.44



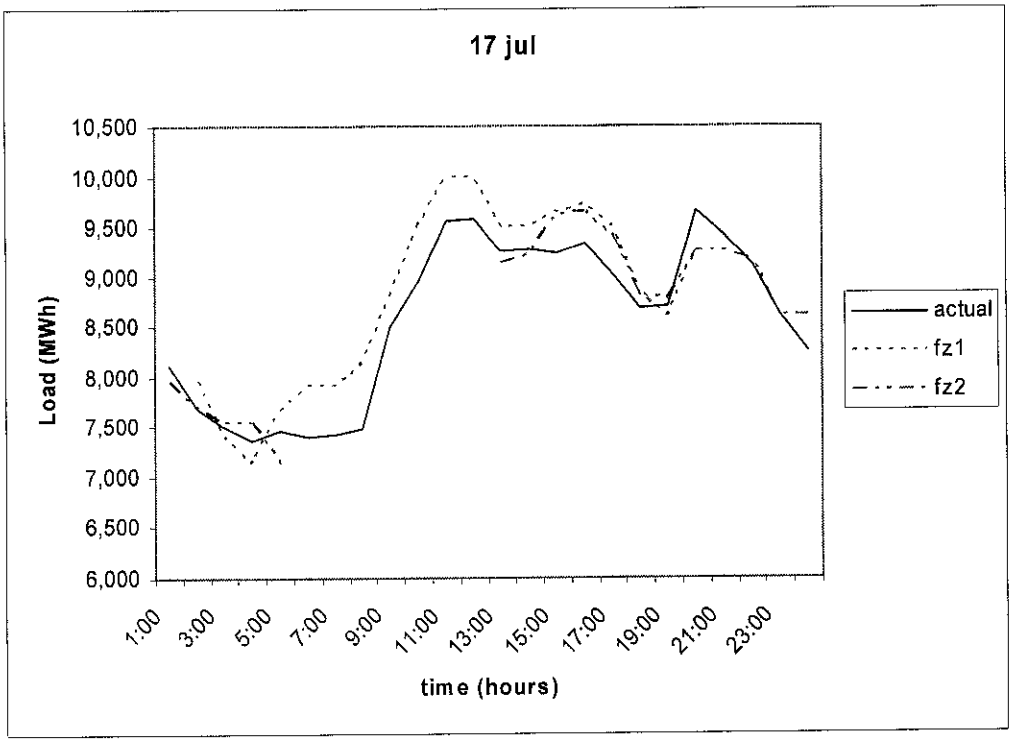
Result of forecast (19 and 17 hours ahead load forecast) data for 16th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Friday	16-Jul-04	1:00	24.1	8,197		8620.4		5.17
		2:00	24.0	7,957	8117.6	7800.3	2.02	1.97
	Fz1 % err	3:00	23.8	7,530	7538.8	7560	0.12	0.40
	1.83	4:00	23.5	7,567	7137.5	7560	5.68	0.09
		5:00	23.4	7,456	7929.7	7137.5	6.35	4.27
	Fz2 % err	6:00	23.3	7,783	7929.7		1.88	
	2.21	7:00	23.6	7,875	7946		0.90	
		8:00	25.6	8,420	8545.8		1.49	
		9:00	27.8	9,748	9865.5		1.21	
		10:00	28.9	10,359	10496.8		1.33	
		11:00	29.6	10,928	10977.3		0.45	
		12:00	30.9	10,824	11007.9		1.70	
		13:00	31.7	10,356	10451.4	10550	0.92	1.87
		14:00	30.5	10,444	10496	10219.8	0.50	2.15
		15:00	24.2	10,794	10915.8	10953.1	1.13	1.47
		16:00	23.7	10,908	11091.4	11091.6	1.68	1.68
		17:00	23.7	10,146	10550	10550	3.98	3.98
		18:00	24.0	9,649	9683.1	9683.2	0.35	0.35
		19:00	24.2	9,488	9250	9250	2.51	2.51
		20:00	24.0	10,224	10278	10277.6	0.53	0.52
		21:00	24.2	9,911		9683.1		2.30
		22:00	24.0	9,554		9250		3.18
		23:00	24.0	8,970		8600		4.12
		0:00	24.0	8,469		8600		1.55



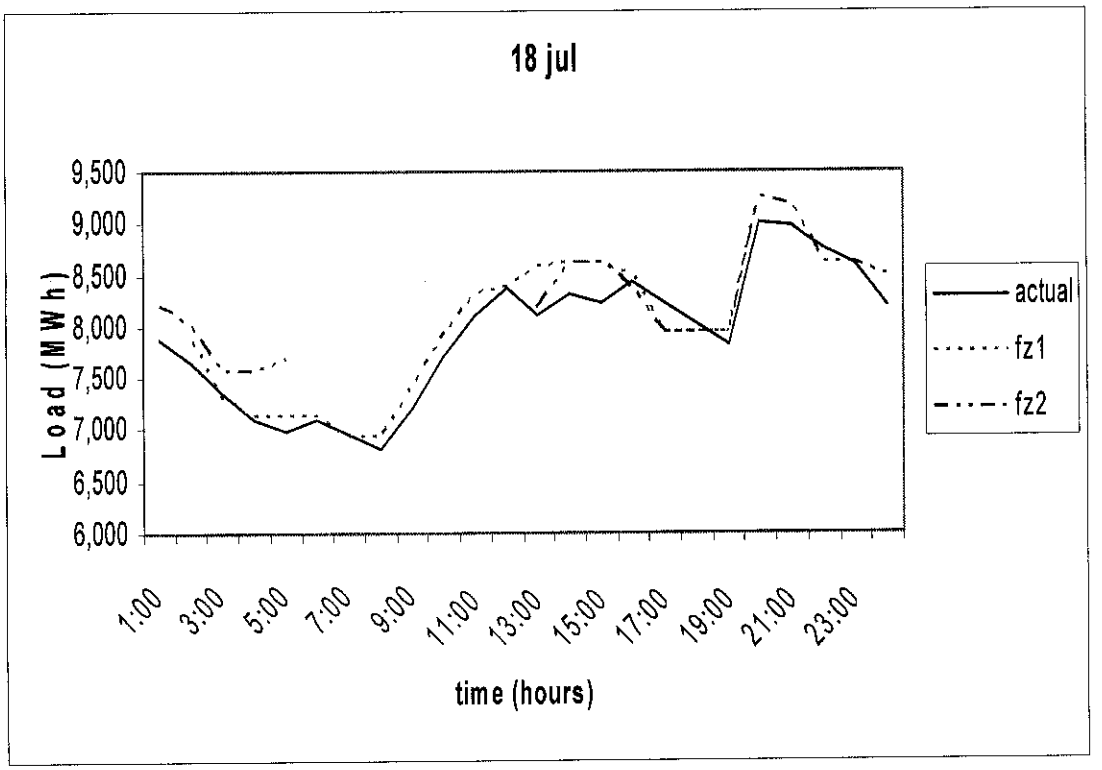
Result of forecast (19 and 17 hours ahead load forecast) data for 17th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Saturday	17-Jul-04	1:00	22.8	8,112		7950		2.00
		2:00	22.9	7,699	7976.8	7690	3.61	0.12
	Fz1 % err	3:00	23.0	7,499	7400.6	7543.7	1.31	0.60
	4.08	4:00	23.0	7,371	7137.5	7543.7	3.17	2.34
		5:00	23.0	7,464	7675.7	7137.5	2.84	4.37
	Fz2 % err	6:00	22.9	7,415	7922		6.84	
	2.13	7:00	23.2	7,429	7922		6.64	
		8:00	23.5	7,486	8142.9		8.78	
		9:00	25.4	8,506	8816.7		3.65	
		10:00	27.4	8,961	9519.5		6.23	
		11:00	28.7	9,558	9994.2		4.56	
		12:00	29.3	9,590	9994.2		4.21	
		13:00	29.6	9,249	9504.5	9144.1	2.76	1.13
		14:00	29.7	9,282	9497.4	9225.4	2.32	0.61
		15:00	30.2	9,245	9636.3	9628.8	4.23	4.15
		16:00	30.4	9,331	9720.6	9645.7	4.18	3.37
		17:00	29.5	9,013	9476.8	9394.5	5.15	4.23
		18:00	28.3	8,692	8816.8	8816.7	1.44	1.43
		19:00	27.2	8,701	8600	8771	1.16	0.80
		20:00	26.7	9,675	9250	9250	4.39	4.39
		21:00	26.3	9,418		9250		1.78
		22:00	25.8	9,106		9150.1		0.48
		23:00	25.4	8,622		8600		0.26
		0:00	25.1	8,253		8600		4.20



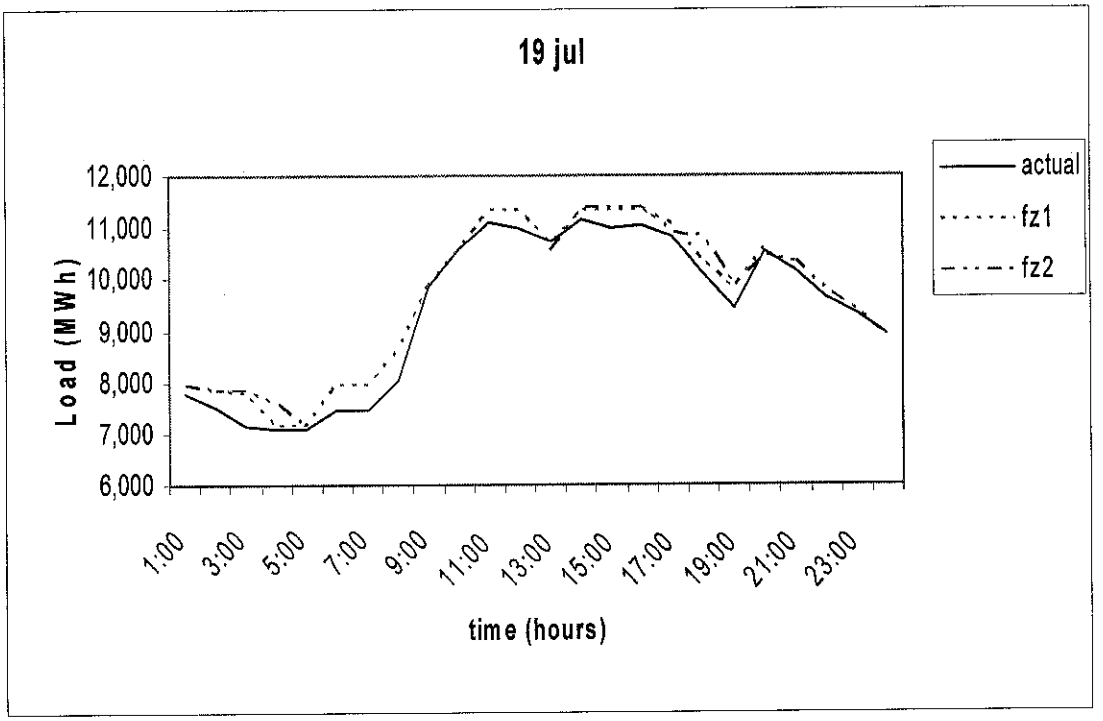
Result of forecast (19 and 17 hours ahead load forecast) data for 18th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
	18-Jul-							
Sunday	04	1:00	24.4	7,870		8204.3		4.25
		2:00	24.2	7,661	7882.6	8015.3	2.89	4.62
	Fz1 % err	3:00	23.9	7,371	7313.7	7559.9	0.78	2.56
	2.12	4:00	23.7	7,112	7137.5	7559.9	0.36	6.30
		5:00	23.7	6,995	7137.5	7675.9	2.04	9.73
	Fz2 % err	6:00	23.5	7,089	7137.5		0.68	
	3.11	7:00	23.4	6,955	6935.3		0.28	
		8:00	25.4	6,824	6935.3		1.63	
		9:00	27.8	7,208	7413.7		2.85	
		10:00	29.9	7,694	7911		2.82	
		11:00	31.0	8,108	8313		2.53	
		12:00	32.4	8,371	8383.4		0.15	
		13:00	32.8	8,106	8569	8171.8	5.71	0.81
		14:00	32.7	8,324	8600	8600	3.32	3.32
		15:00	32.2	8,224	8600	8600	4.57	4.57
		16:00	32.5	8,416	8497.3	8383.3	0.97	0.39
		17:00	31.8	8,223	7950	7950	3.32	3.32
		18:00	30.5	8,034	7950	7950	1.05	1.05
		19:00	28.6	7,817	7950	7950	1.70	1.70
		20:00	28.0	9,008	9250	9250	2.69	2.69
		21:00	26.6	8,979		9170.4		2.13
		22:00	25.9	8,759		8600		1.82
		23:00	25.7	8,602		8600		0.02
		0:00	25.3	8,190		8481.8		3.56



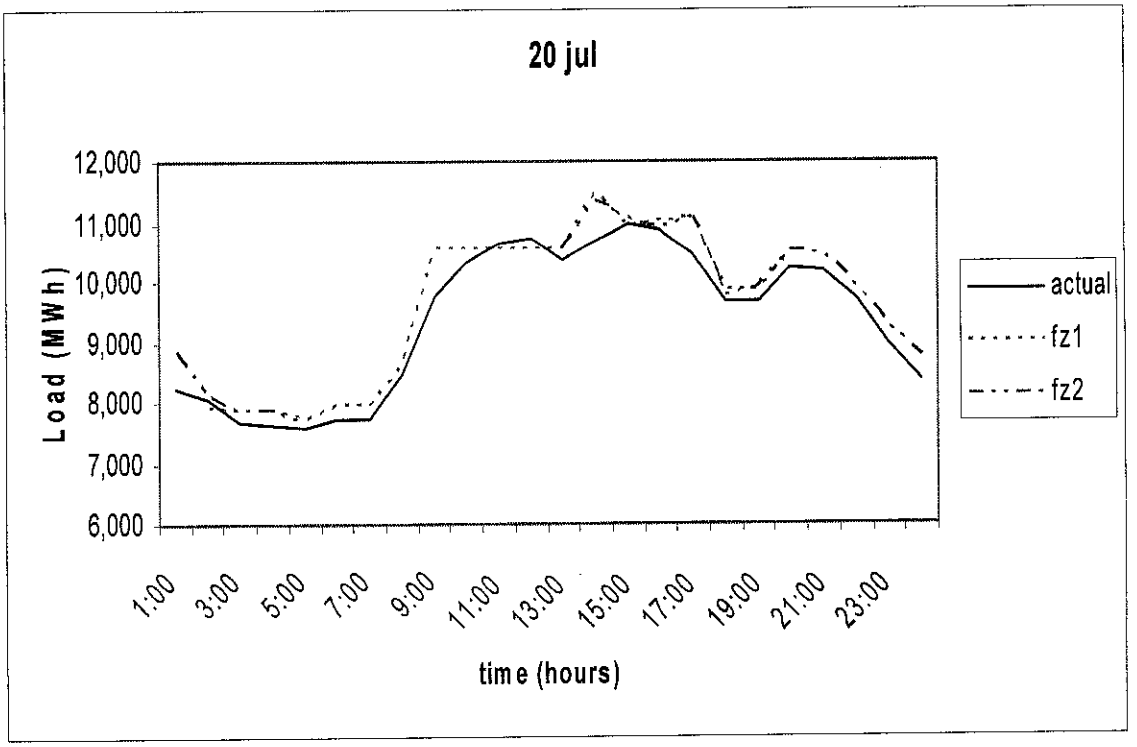
Result of forecast (19 and 17 hours ahead load forecast) data for 19th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Monday	19-Jul-04	1:00	24.9	7,750		7950		2.58
		2:00	24.3	7,491	7848.9	7839	4.78	4.65
	Fz1 % err	3:00	24.2	7,141	7753.7	7841.6	8.58	9.81
	2.95	4:00	23.8	7,110	7137.5	7559.9	0.39	6.33
		5:00	23.8	7,076	7137.5	7137.5	0.87	0.87
	Fz2 % err	6:00	24.0	7,435	7938.3		6.77	
	2.99	7:00	24.6	7,485	7947.7		6.18	
		8:00	27.7	8,016	8591.8		7.18	
		9:00	28.7	9,874	9880.2		0.06	
		10:00	30.2	10,589	10516.4		0.69	
		11:00	30.0	11,105	11339.2		2.11	
		12:00	31.2	11,033	11342.6		2.81	
		13:00	32.3	10,752	10694.8	10527.6	0.53	2.09
		14:00	30.7	11,191	11342.6	11351.2	1.35	1.43
		15:00	30.3	11,024	11342.6	11351.2	2.89	2.97
		16:00	30.7	11,074	11342.6	11349.5	2.43	2.49
		17:00	31.6	10,834	11068.9	10892.8	2.17	0.54
		18:00	30.5	10,130	10316.4	10863.9	1.84	7.24
		19:00	28.8	9,436	9806.6	9877	3.93	4.67
		20:00	27.6	10,519	10575.3	10440.9	0.54	0.74
		21:00	27.3	10,176		10345.7		1.67
		22:00	27.0	9,661		9756.7		0.99
		23:00	26.5	9,326		9392.1		0.71
		0:00	26.2	8,946		8852		1.05



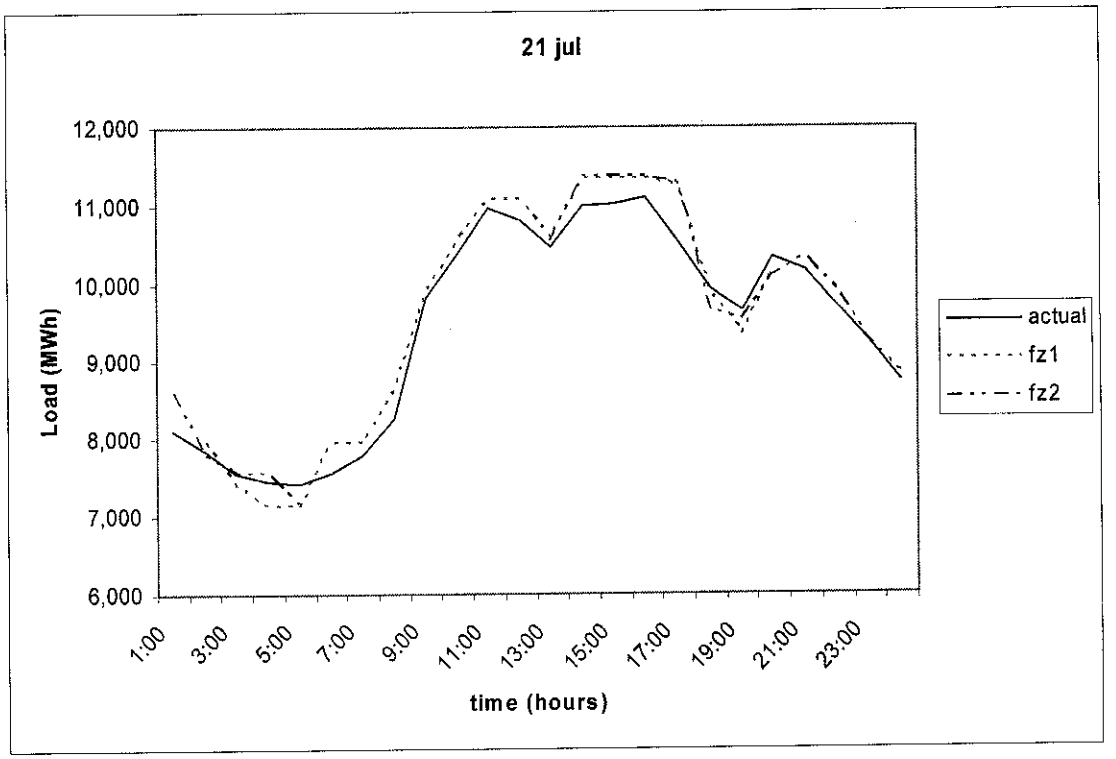
Result of forecast (19 and 17 hours ahead load forecast) data for 20th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
	20-Jul-							
Tuesday	04	1:00	25.7	8,233		8852		7.52
		2:00	25.6	8,062	7890.4	8099.4	2.13	0.46
	Fz1 % err	3:00	25.7	7,686	7841.6	7841.6	2.02	2.02
	2.76	4:00	25.6	7,632	7841.6	7841.6	2.75	2.75
		5:00	22.0	7,560	7719.3	7685.5	2.11	1.66
	Fz2 % err	6:00	22.3	7,724	7942.9		2.83	
	2.76	7:00	22.5	7,705	7948.6		3.16	
		8:00	23.1	8,443	8595		1.80	
		9:00	23.5	9,748	10538.6		8.11	
		10:00	24.7	10,318	10541		2.16	
		11:00	27.0	10,669	10550		1.12	
		12:00	28.0	10,727	10550		1.65	
		13:00	24.5	10,353	10550	10550	1.90	1.90
		14:00	24.8	10,703	11478.4	11362.5	7.24	6.16
		15:00	26.0	10,967	10939.9	11055.5	0.25	0.81
		16:00	27.1	10,903	11025.9	10896.1	1.13	0.06
		17:00	27.0	10,476	11047.9	11047.9	5.46	5.46
		18:00	26.4	9,691	9880.2	9778	1.95	0.90
		19:00	25.8	9,658	9880.2	9890.1	2.30	2.40
		20:00	25.1	10,238	10473.2	10510.8	2.30	2.66
		21:00	24.9	10,173		10469.2		2.91
		22:00	24.6	9,698		9890.1		1.98
		23:00	24.5	8,974		9250		3.08
		0:00	24.0	8,380		8734.7		4.23



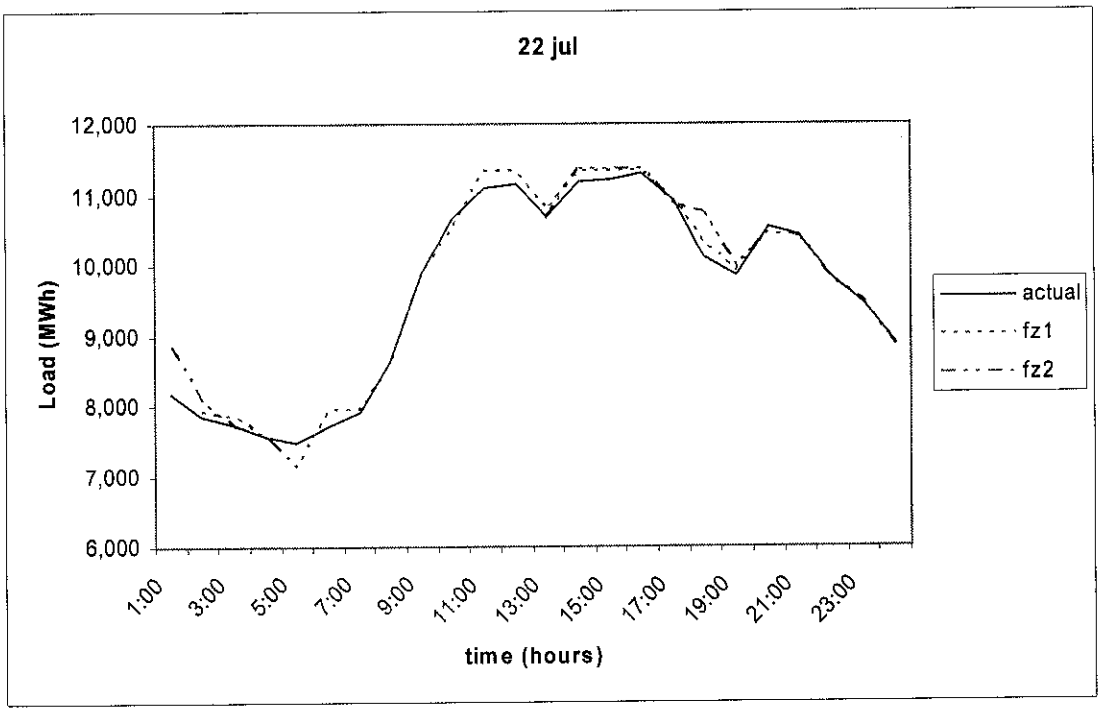
Result of forecast (19 and 17 hours ahead load forecast) data for 21st July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
	21-Jul-							
Wednesday	04	1:00	23.7	8,106		8600		6.09
		2:00	23.6	7,839	7966.4	7800.2	1.63	0.49
	Fz1 % err	3:00	23.5	7,550	7390.8	7560	2.11	0.13
	2.58	4:00	23.2	7,435	7137.5	7560	4.00	1.68
		5:00	23.2	7,429	7137.5	7137.5	3.92	3.92
	Fz2 % err	6:00	23.1	7,562	7940.6		5.01	
	2.34	7:00	23.5	7,789	7948.2		2.04	
		8:00	25.3	8,272	8593.4		3.89	
		9:00	27.4	9,834	9884		0.51	
		10:00	28.8	10,376	10523		1.42	
		11:00	29.5	10,964	11069		0.96	
		12:00	29.7	10,808	11072.4		2.45	
		13:00	30.0	10,471	10581.6	10561	1.06	0.86
		14:00	28.7	11,004	11346.5	11357.8	3.11	3.22
		15:00	29.4	11,033	11351.4	11362.5	2.89	2.99
		16:00	29.5	11,115	11349.7	11362.5	2.11	2.23
		17:00	29.2	10,563	11256.5	11288.7	6.57	6.87
		18:00	28.6	9,958	9894.3	9667.8	0.64	2.91
		19:00	28.0	9,659	9344.4	9513.3	3.26	1.51
		20:00	27.1	10,333	10190.5	10105.3	1.38	2.20
		21:00	26.0	10,184		10329.3		1.43
		22:00	25.6	9,702		9895.7		2.00
		23:00	25.5	9,255		9250		0.05
		0:00	25.5	8,746		8852		1.21



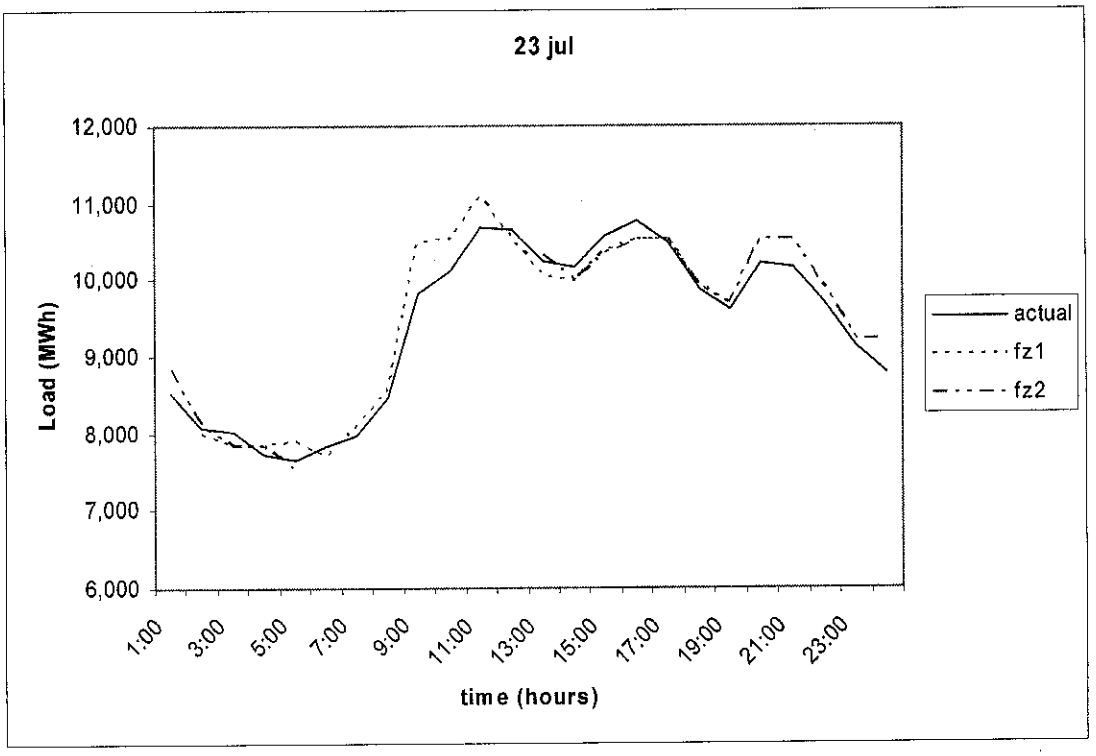
Result of forecast (19 and 17 hours ahead load forecast) data for 22nd July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Thursday	22-Jul-04	1:00	25.2	8,187		8852		8.12
		2:00	24.7	7,861	7916.2	8074.2	0.70	2.71
	Fz1 % err	3:00	24.7	7,751	7841.6	7724.3	1.17	0.34
	1.21	4:00	24.2	7,551	7559.9	7560	0.12	0.12
		5:00	24.2	7,470	7137.5	7137.5	4.45	4.45
	Fz2 % err	6:00	23.9	7,704	7940		3.06	
	1.69	7:00	24.4	7,900	7948.1		0.61	
		8:00	25.8	8,638	8593.1		0.52	
		9:00	28.7	9,908	9883.1		0.25	
		10:00	30.5	10,654	10521.5		1.24	
		11:00	31.7	11,105	11342.6		2.14	
		12:00	32.0	11,146	11345.6		1.79	
		13:00	32.5	10,690	10770	10674.7	0.75	0.14
		14:00	32.4	11,197	11345.6	11349.5	1.33	1.36
		15:00	32.4	11,222	11345.6	11349.5	1.10	1.14
		16:00	32.0	11,306	11345.4	11349.5	0.35	0.38
		17:00	31.3	10,920	10934	10863.9	0.13	0.51
		18:00	29.6	10,115	10318.5	10745.4	2.01	6.23
		19:00	28.6	9,853	9905.9	9985.2	0.54	1.34
		20:00	28.0	10,540	10465.8	10468.6	0.70	0.68
		21:00	27.8	10,441		10404.3		0.35
		22:00	27.1	9,817		9800.3		0.17
		23:00	26.5	9,439		9439.4		0.00
		0:00	26.0	8,913		8851.9		0.69



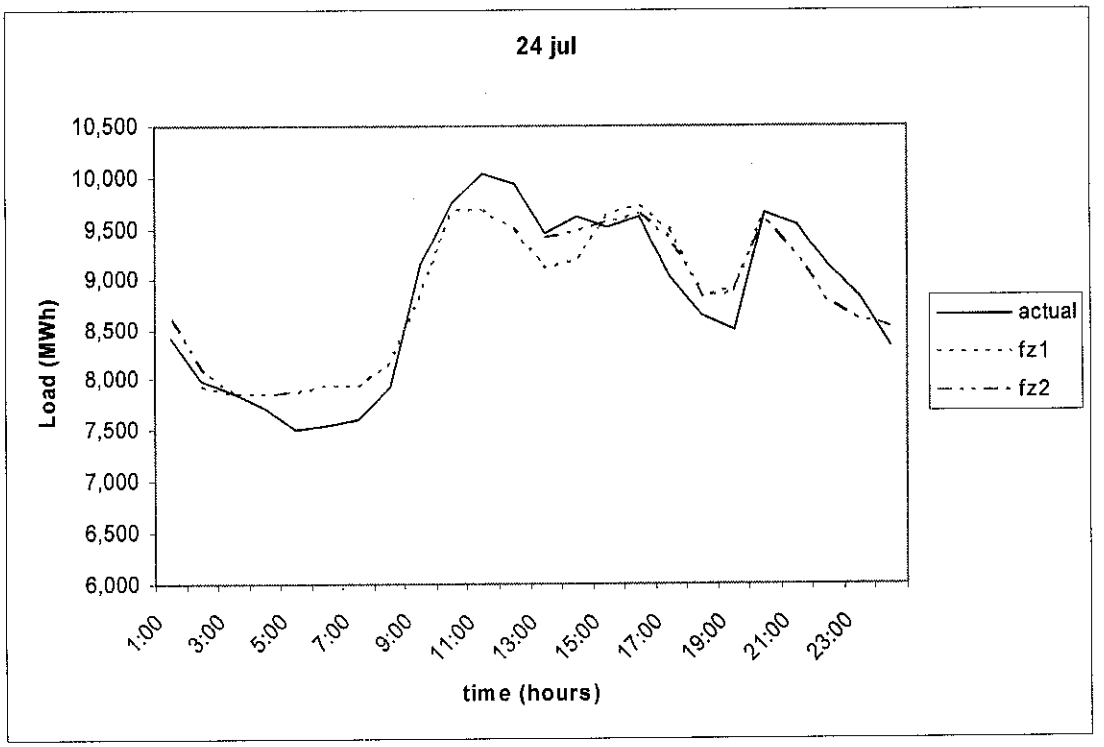
Result of forecast (19 and 17 hours ahead load forecast) data for 23rd July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Friday	23-Jul-04	1:00	26.0	8,527		8851.9		3.81
		2:00	26.5	8,071	7987.5	8109.6	1.03	0.48
	Fz1 % err	3:00	25.5	8,014	7841.6	7841.6	2.15	2.15
	2.13	4:00	25.2	7,716	7841.6	7841.6	1.63	1.63
		5:00	25.3	7,641	7879.3	7501.6	3.12	1.82
	Fz2 % err	6:00	23.9	7,821	7692		1.65	
	1.94	7:00	22.2	7,964	8068.9		1.32	
		8:00	22.5	8,464	8545.8		0.97	
		9:00	22.7	9,832	10525.7		7.06	
		10:00	23.8	10,113	10530.9		4.13	
		11:00	23.7	10,688	11091.6		3.78	
		12:00	24.6	10,666	10550		1.09	
		13:00	26.5	10,236	10054.7	10333.3	1.77	0.95
		14:00	27.7	10,170	9973.4	9973.5	1.93	1.93
		15:00	29.3	10,605	10368.9	10359.5	2.23	2.31
		16:00	29.9	10,768	10550	10550	2.02	2.02
		17:00	30.6	10,511	10550	10550	0.37	0.37
		18:00	30.3	9,876	9900	9900	0.24	0.24
		19:00	29.3	9,609	9683.4	9683.3	0.77	0.77
		20:00	28.5	10,228	10550	10550	3.15	3.15
		21:00	27.8	10,175		10550		3.69
		22:00	27.2	9,707		9900		1.99
		23:00	26.9	9,142		9212.2		0.77
		0:00	26.5	8,790		9218.8		4.88



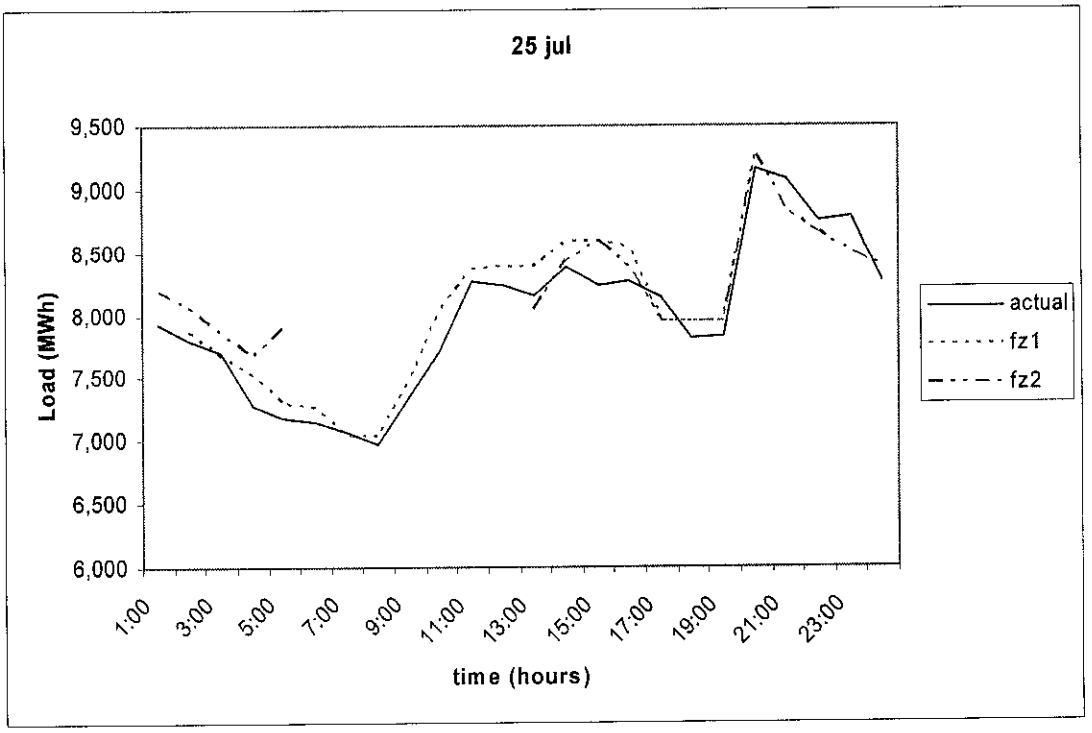
Result of forecast (19 and 17 hours ahead load forecast) data for 24th July 2004

date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
24-Jul-04							
Saturday	1:00	26.0	8,412		8600		2.23
	2:00	26.0	7,991	7935.8	8085.2	0.69	1.18
Fz1 % err	3:00	25.7	7,863	7841.6	7841.6	0.27	0.27
2.87	4:00	25.6	7,725	7841.6	7841.6	1.51	1.51
	5:00	22.0	7,511	7868.7	7868.7	4.76	4.76
Fz2 % err	6:00	21.7	7,550	7928.8		5.02	
2.15	7:00	21.9	7,601	7928.8		4.31	
	8:00	22.3	7,921	8149.4		2.88	
	9:00	23.5	9,140	8816.7		3.54	
	10:00	24.1	9,753	9674.6		0.80	
	11:00	25.9	10,045	9683.2		3.60	
	12:00	27.8	9,930	9477.7		4.55	
	13:00	29.6	9,459	9092.6	9407.9	3.87	0.54
	14:00	30.6	9,613	9173.4	9476.7	4.57	1.42
	15:00	31.3	9,517	9636.1	9554.7	1.25	0.40
	16:00	30.6	9,624	9720.3	9642.4	1.00	0.19
	17:00	29.9	9,009	9476.6	9390.9	5.19	4.24
	18:00	29.3	8,634	8816.8	8816.7	2.12	2.12
	19:00	27.6	8,489	8860.3	8895.7	4.37	4.79
	20:00	27.1	9,666	9650.5	9592.3	0.16	0.76
	21:00	26.3	9,528		9220.3		3.23
	22:00	25.6	9,132		8750.1		4.18
	23:00	24.8	8,822		8600		2.52
	0:00	24.7	8,330		8507.3		2.13



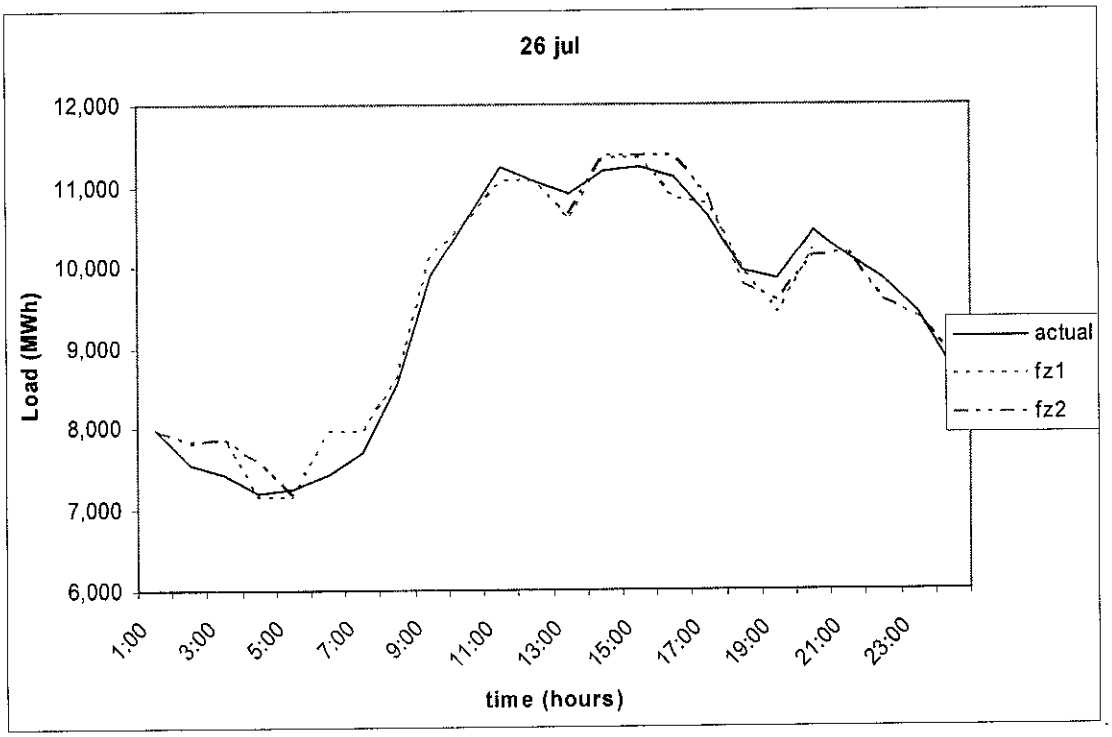
Result of forecast (19 and 17 hours ahead load forecast) data for 25th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
	25-Jul-							
Sunday	04	1:00	24.8	7,926		8187.8		3.30
		2:00	24.5	7,793	7857.1	8053	0.82	3.34
	Fz1 % err							
	1.99	3:00	24.6	7,708	7665.8	7841.6	0.55	1.73
		4:00	24.5	7,278	7521.6	7665.5	3.35	5.32
		5:00	24.8	7,178	7300	7895.8	1.70	10.00
	Fz2 % err							
	2.74	6:00	24.9	7,156	7271.5		1.61	
		7:00	25.0	7,076	7036		0.57	
		8:00	27.1	6,977	7036		0.85	
		9:00	28.4	7,355	7481.3		1.72	
		10:00	29.7	7,724	8045.9		4.17	
		11:00	29.8	8,263	8363.3		1.21	
		12:00	31.0	8,244	8383.4		1.69	
		13:00	32.2	8,161	8383.4	8043.2	2.73	1.44
		14:00	32.0	8,388	8600	8427.3	2.53	0.47
		15:00	31.9	8,240	8600	8600	4.37	4.37
		16:00	31.8	8,266	8541	8383.2	3.33	1.42
		17:00	31.4	8,146	7950	7950	2.41	2.41
		18:00	31.3	7,822	7950	7950	1.64	1.64
		19:00	30.3	7,825	7950	7950	1.60	1.60
		20:00	29.4	9,163	9250	9250	0.95	0.95
		21:00	28.5	9,076		8816.8		2.86
		22:00	27.8	8,756		8658.9		1.11
		23:00	27.5	8,781		8490.5		3.31
		0:00	27.0	8,268		8383.2		1.39



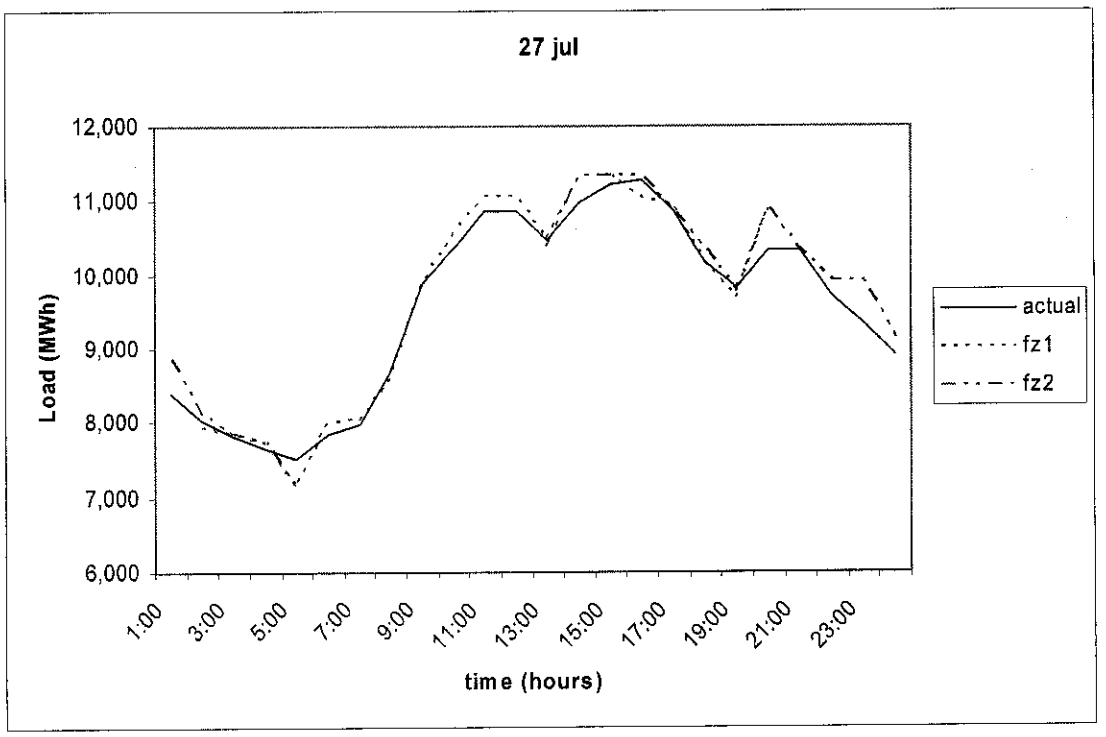
Result of forecast (19 and 17 hours ahead load forecast) data for 26th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
	26-Jul-							
Monday	04	1:00	26.2	7,985		7950		0.44
		2:00	25.5	7,550	7803.7	7810.7	3.36	3.45
	Fz1 % err	3:00	24.2	7,417	7841.6	7841.6	5.72	5.72
	2.27	4:00	23.6	7,202	7137.5	7559.9	0.90	4.97
		5:00	23.3	7,248	7137.5	7137.5	1.52	1.52
	Fz2 % err	6:00	23.4	7,418	7942.3		7.07	
	2.25	7:00	23.9	7,702	7948.5		3.20	
		8:00	24.8	8,534	8594.6		0.71	
		9:00	27.6	9,904	10120.1		2.18	
		10:00	28.9	10,560	10527.9		0.30	
		11:00	29.7	11,239	11073.1		1.48	
		12:00	29.9	11,053	11075.9		0.21	
		13:00	29.9	10,921	10573.2	10666.2	3.18	2.33
		14:00	30.5	11,195	11349.5	11358.1	1.38	1.46
		15:00	31.1	11,244	11349.5	11358.1	0.94	1.01
		16:00	31.1	11,125	10837.5	11358.1	2.58	2.10
		17:00	30.3	10,631	10785.3	10864.9	1.45	2.20
		18:00	29.4	9,938	9949.1	9770.8	0.11	1.68
		19:00	28.7	9,852	9418.1	9567.5	4.40	2.89
		20:00	27.9	10,465	10220.6	10138	2.34	3.12
		21:00	27.3	10,123		10143.5		0.20
		22:00	26.9	9,858		9559.6		3.03
		23:00	26.8	9,447		9357.7		0.95
		0:00	26.3	8,744		8852		1.24



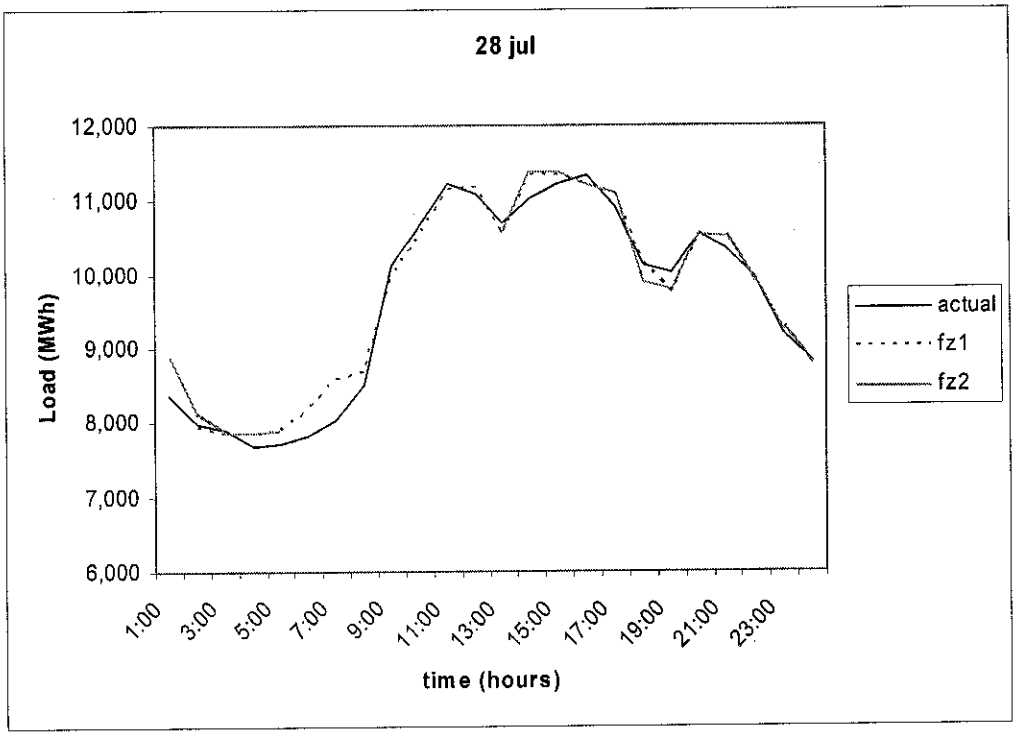
Result of forecast (19 and 17 hours ahead load forecast) data for 27th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Tuesday	27-Jul-04	1:00	26.1	8,381		8852		5.62
		2:00	25.7	8,042	7923	8109.7	1.48	0.84
	Fz1 % err	3:00	25.2	7,808	7841.6	7841.6	0.43	0.43
	1.64	4:00	24.2	7,661	7693.5	7724.3	0.42	0.83
		5:00	24.5	7,508	7137.5	7137.5	4.93	4.93
	Fz2 % err	6:00	24.3	7,845	7997.2		1.94	
	2.20	7:00	24.7	7,977	8029.9		0.66	
		8:00	27.0	8,697	8595		1.17	
		9:00	27.7	9,889	9887.9		0.01	
		10:00	28.9	10,343	10527.9		1.79	
		11:00	30.1	10,873	11073.1		1.84	
		12:00	30.9	10,878	11076		1.82	
		13:00	32.1	10,493	10474.9	10394.4	0.17	0.94
		14:00	31.5	10,985	11349.5	11352.5	3.32	3.35
		15:00	30.8	11,219	11349.5	11352.5	1.16	1.19
		16:00	30.7	11,274	11047.3	11352.5	2.01	0.70
		17:00	30.9	10,865	10944.7	10865.9	0.73	0.01
		18:00	30.5	10,171	10181.3	10389.6	0.10	2.15
		19:00	30.0	9,812	9678.7	9768.4	1.36	0.44
		20:00	29.4	10,355	10950.9	10886	5.75	5.13
		21:00	28.4	10,339		10348.8		0.09
		22:00	27.7	9,715		9914.6		2.05
		23:00	27.2	9,328		9920.8		6.36
		0:00	27.4	8,925		9128.3		2.28



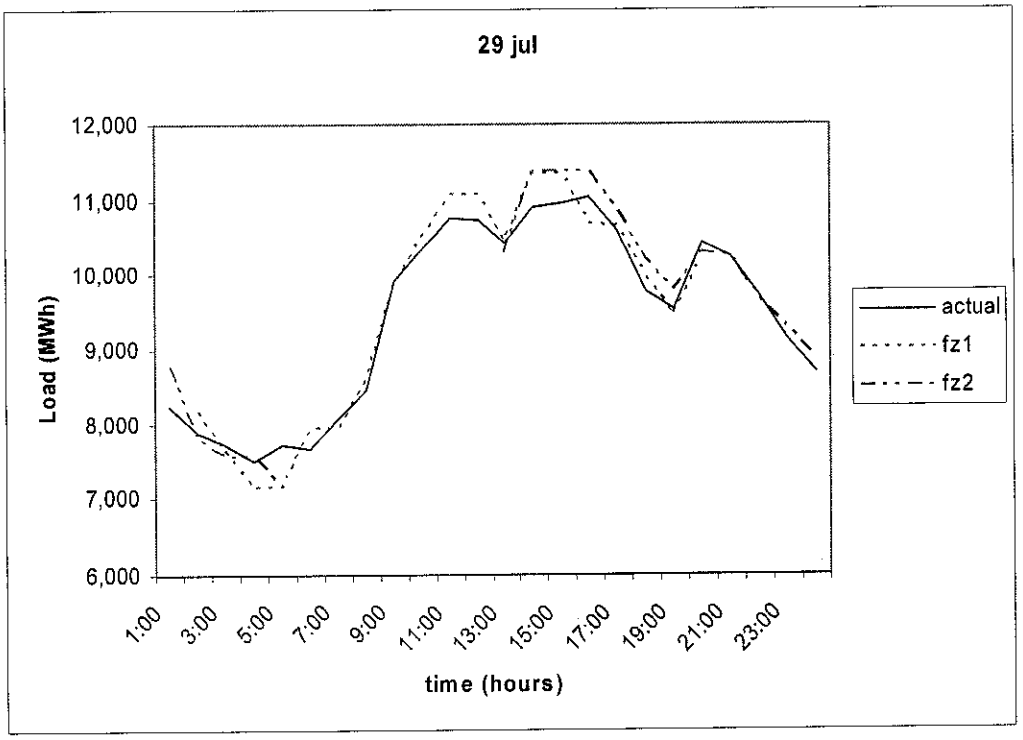
Result of forecast (19 and 17 hours ahead load forecast) data for 28th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Wednesday	28-Jul-04	1:00	27.3	8,374		8851.9		5.71
		2:00	26.9	7,991	7922.5	8107.6	0.86	1.46
	Fz1 % err	3:00	26.5	7,906	7841.6	7841.6	0.81	0.81
	1.85	4:00	26.0	7,683	7841.6	7841.6	2.06	2.06
		5:00	26.0	7,718	7868.7	7868.7	1.95	1.95
	Fz2 % err	6:00	25.7	7,828	8163.6		4.29	
	1.67	7:00	26.0	8,032	8595.3		7.01	
		8:00	26.5	8,516	8668.1		1.79	
		9:00	28.5	10,140	9960.6		1.77	
		10:00	29.9	10,689	10530.9		1.48	
		11:00	30.4	11,223	11143.9		0.70	
		12:00	30.8	11,089	11172		0.75	
		13:00	29.5	10,717	10545.9	10582.9	1.60	1.25
		14:00	29.1	11,041	11350.4	11357.8	2.80	2.87
		15:00	27.9	11,222	11350.4	11357.8	1.14	1.21
		16:00	27.7	11,333	11188.4	11195.4	1.28	1.21
		17:00	27.2	10,925	11092.6	11092.6	1.53	1.53
		18:00	26.9	10,140	10132.5	9888.4	0.07	2.48
		19:00	26.3	10,024	9736	9772.1	2.87	2.51
		20:00	26.1	10,562	10531.7	10531.7	0.29	0.29
		21:00	25.9	10,350		10524.1		1.68
		22:00	25.6	9,969		9895.4		0.74
		23:00	25.3	9,195		9250		0.60
		0:00	25.1	8,825		8817.5		0.08



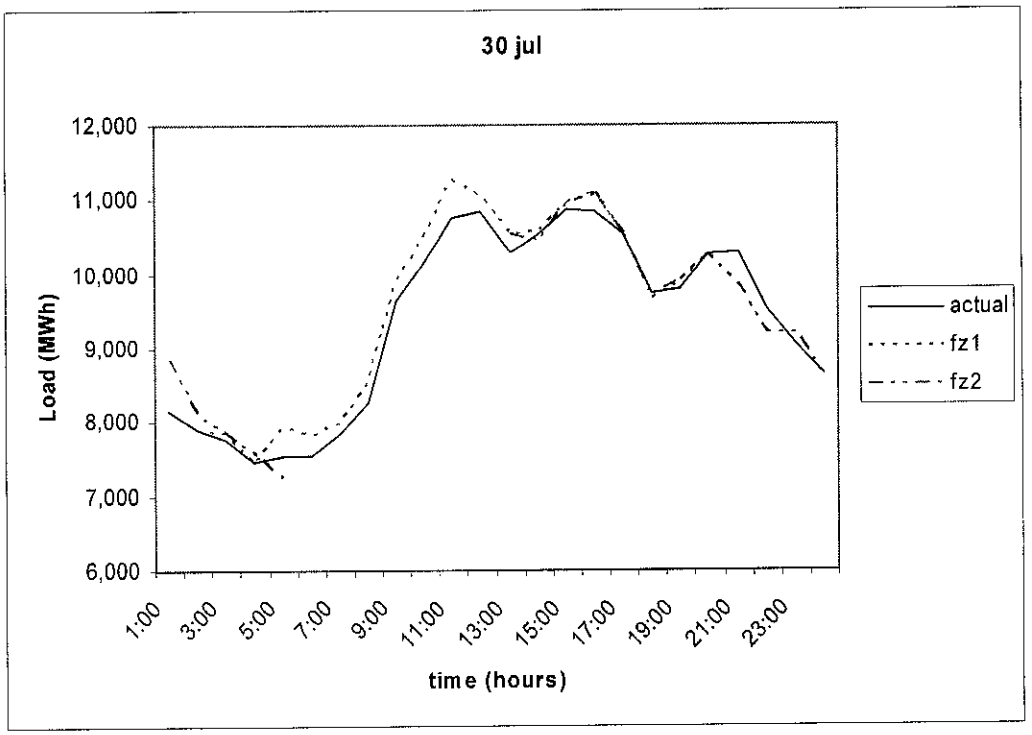
Result of forecast (19 and 17 hours ahead load forecast) data for 29th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Thursday	29-Jul-04	1:00	24.2	8,244		8781.5		6.52
		2:00	23.9	7,889	8190.6	7800.4	3.82	1.12
	Fz1 % err	3:00	23.0	7,709	7615.2	7560	1.22	1.93
	2.53	4:00	23.2	7,507	7137.5	7560	4.92	0.71
		5:00	23.0	7,719	7137.5	7137.5	7.53	7.53
	Fz2 % err	6:00	22.9	7,670	7939.3		3.51	
	2.63	7:00	23.0	8,061	7947.9		1.40	
		8:00	25.2	8,444	8592.5		1.76	
		9:00	26.6	9,936	9881.8		0.55	
		10:00	29.0	10,370	10519.3		1.44	
		11:00	29.9	10,768	11065.7		2.76	
		12:00	31.2	10,753	11069.7		2.95	
		13:00	31.2	10,436	10472.2	10303.4	0.35	1.27
		14:00	31.0	10,904	11344.3	11359.3	4.04	4.18
		15:00	31.3	10,972	11344.3	11359.2	3.39	3.53
		16:00	31.7	11,033	10683.4	11359.2	3.17	2.96
		17:00	30.7	10,597	10664.2	10866.7	0.63	2.55
		18:00	29.1	9,790	9983.5	10208.6	1.98	4.28
		19:00	28.3	9,540	9470.3	9801.7	0.73	2.74
		20:00	28.0	10,446	10237.8	10299.7	1.99	1.40
		21:00	27.3	10,257		10268.1		0.11
		22:00	26.7	9,726		9683.4		0.44
		23:00	26.4	9,140		9283.9		1.57
		0:00	25.9	8,691		8851.9		1.85



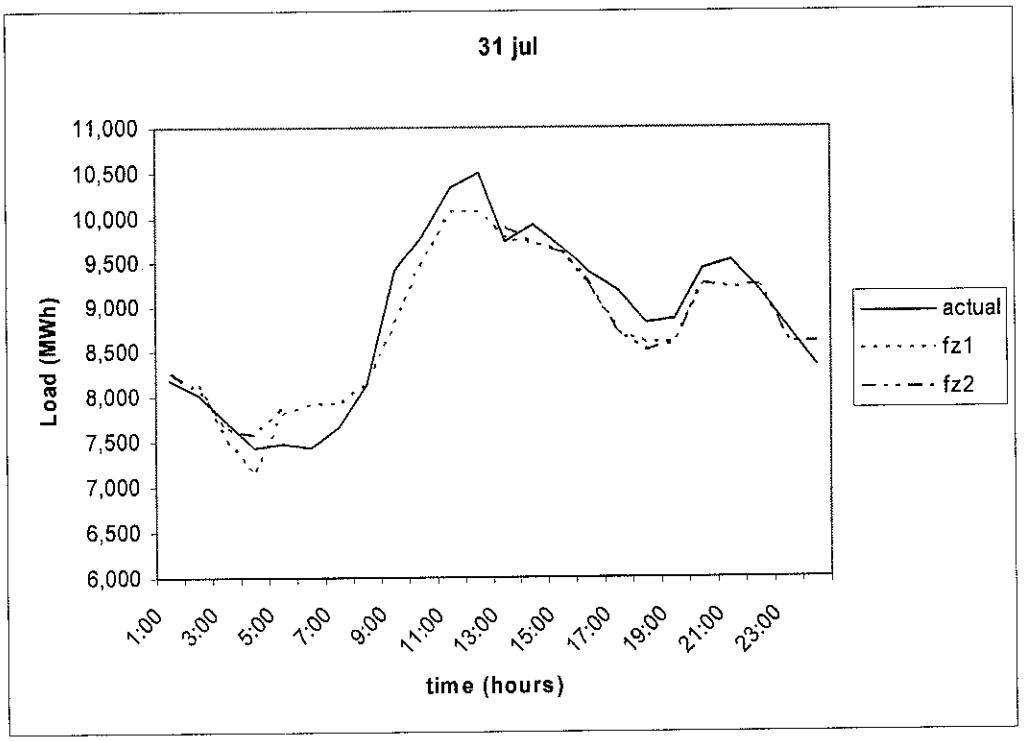
Result of forecast (19 and 17 hours ahead load forecast) data for 30th July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Friday	30-Jul-04	1:00	25.4	8,138		8851.9		8.77
		2:00	24.9	7,888	7882.5	8085.4	0.07	2.50
	Fz1 % err	3:00	24.6	7,765	7841.6	7841.5	0.99	0.99
	1.88	4:00	24.4	7,458	7439.3	7560	0.25	1.37
		5:00	24.0	7,539	7926.8	7221.9	5.14	4.21
	Fz2 % err	6:00	24.0	7,555	7825.1		3.58	
	2.14	7:00	24.4	7,835	7986.3		1.93	
		8:00	26.3	8,249	8545.8		3.60	
		9:00	27.4	9,642	9871.9		2.38	
		10:00	30.0	10,147	10506.7		3.54	
		11:00	30.7	10,753	11253.6		4.66	
		12:00	31.5	10,855	11058.7		1.88	
		13:00	32.3	10,282	10535.5	10550	2.47	2.61
		14:00	30.3	10,549	10574.9	10459.5	0.25	0.85
		15:00	24.4	10,860	10951.9	10958.1	0.85	0.90
		16:00	25.4	10,832	11063.2	11091.6	2.13	2.40
		17:00	25.8	10,538	10503.8	10550	0.32	0.11
		18:00	25.4	9,738	9665.7	9683.4	0.74	0.56
		19:00	25.3	9,786	9870.4	9900	0.86	1.16
		20:00	24.7	10,260	10247.9	10241.1	0.12	0.18
		21:00	24.6	10,287		9833.5		4.41
		22:00	24.7	9,530		9202.5		3.44
		23:00	24.7	9,064		9202.5		1.53
		0:00	24.3	8,641		8600		0.47



Result of forecast (19 and 17 hours ahead load forecast) data for 31st July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Saturday	31-Jul-04	1:00	24.3	8,190		8256.4		0.81
		2:00	24.3	8,023	8136.1	8063.1	1.41	0.50
	Fz1 % err	3:00	24.1	7,724	7527.2	7635.7	2.55	1.14
	2.91	4:00	24.4	7,422	7137.5	7560	3.83	1.86
		5:00	23.9	7,488	7798.9	7868.7	4.15	5.08
	Fz2 % err	6:00	23.8	7,439	7919.9		6.46	
	2.19	7:00	24.0	7,661	7919.9		3.38	
		8:00	24.5	8,138	8140.9		0.04	
		9:00	26.4	9,406	8785.8		6.59	
		10:00	28.1	9,816	9514.1		3.08	
		11:00	29.2	10,334	10066		2.59	
		12:00	30.2	10,504	10078.6		4.05	
		13:00	30.2	9,745	9765.5	9879.8	0.21	1.38
		14:00	30.3	9,924	9720.2	9720.4	2.05	2.05
		15:00	26.8	9,691	9635.9	9604.6	0.57	0.89
		16:00	26.3	9,378	9216	9230.3	1.73	1.57
		17:00	27.5	9,187	8702.6	8707.2	5.27	5.22
		18:00	27.7	8,828	8600	8507.2	2.58	3.63
		19:00	27.0	8,855	8600	8600	2.88	2.88
		20:00	26.5	9,424	9250	9250	1.85	1.85
		21:00	26.5	9,519		9204.5		3.30
		22:00	26.3	9,187		9223.9		0.40
		23:00	26.1	8,740		8600		1.60
		0:00	26.0	8,348		8600		3.02



APPENDIX D

RESULT OF FORECAST DATA (1 MONTH AHEAD LOAD FORECAST)

Forecast result from 1 month ahead load forecast for 1st to 31st July 2004

	date	time	temp	actual load	Fz1	Fz2	err Fz1	err Fz2
Thursday	1-Jul-04	1:00	24.9	8,738			100.00	
		2:00	24.8	8,513	8355.5		1.85	
	Fz1 % err	3:00	24.7	8,278	8158.8		1.44	
	1.72	4:00	24.8	8,126	7766.3		4.43	
		5:00	25.0	7,879	7645.6		2.96	
	Fz2 % err	6:00	24.8	8,029	8073.8		0.56	
	2.27	7:00	25.1	8,343	8323.7		0.23	
		8:00	26.7	8,457	8595.2		1.63	
		9:00	28.5	9,878	9888.4		0.11	
		10:00	29.1	10,434	10530.3		0.92	
		11:00	30.9	10,853	11075		2.05	
		12:00	32.2	10,953	11077.6		1.14	
		13:00	33.0	10,729	10698.9	10677.4	0.28	0.48
		14:00	32.2	11,132	11350.9	11351.9	1.97	1.98
		15:00	32.1	11,146	11350.9	11351.9	1.84	1.85
		16:00	33.0	11,334	11063.8	11351.9	2.38	0.16
		17:00	31.7	10,766	11155	10967.7	3.61	1.87
		18:00	30.3	9,931	10313.4	10967.7	3.85	10.44
		19:00	29.0	9,876	9806.7	9911.6	0.70	0.36
		20:00	28.3	10,666	10589.7	10448.9	0.72	2.04
		21:00	28.1	10,587		10362.1		2.12
		22:00	27.4	10,084		9840.9		2.41
		23:00	27.0	9,807		9682.8		1.27
		0:00	26.8	9,199		8991.5		2.26
Friday	2-Jul-04	1:00	27.1	8,988		8852		1.51
		2:00	26.9	8,569	8672.5	8109.7	1.21	5.36
	Fz1 % err	3:00	26.5	8,292	8145	7841.6	1.77	5.43
	1.68	4:00	26.3	8,022	7841.6	7841.6	2.25	2.25
		5:00	26.2	8,079	7868.7	7868.7	2.60	2.60
	Fz2 % err	6:00	26.1	8,322	7894.8		5.13	
	2.52	7:00	25.0	8,245	8248.5		0.04	
		8:00	26.5	8,942	8545.8		4.43	
		9:00	28.5	10,073	9878.9		1.93	
		10:00	31.2	10,691	10517.4		1.62	
		11:00	32.6	11,235	11337.8		0.91	
		12:00	33.9	11,352	11334.4		0.16	
		13:00	34.6	10,732	10787.1	10550	0.51	1.70

		14:00	34.8	10,979	11058.1	11091.6	0.72	1.03
		15:00	35.7	11,335	11334.4	11362.5	0.01	0.24
		16:00	35.5	11,600	11334.4	11362.5	2.29	2.05
		17:00	35.1	11,090	11345.1	11362.5	2.30	2.46
		18:00	32.1	10,331	10523.6	10550	1.86	2.12
		19:00	30.3	9,605	9671.6	9683.3	0.69	0.82
		20:00	29.5	10,700	10535.6	10550	1.54	1.40
		21:00	29.2	10,520		10550		0.29
		22:00	29.0	10,113		10550		4.32
		23:00	28.7	9,942		9250		6.96
		0:00	28.0	9,433		9218.8		2.27
Saturday	3-Jul-04	1:00	27.2	8,700		8600		1.15
		2:00	26.8	8,611	8210.9	8085.3	4.65	6.10
	Fz1 % err	3:00	26.0	8,293	7989.5	7841.6	3.66	5.44
	1.59	4:00	24.0	7,999	7841.6	7841.6	1.97	1.97
		5:00	23.6	8,025	7675.8	7911	4.35	1.42
	Fz2 % err	6:00	23.7	7,817	7928.6		1.43	
	1.95	7:00	24.0	7,907	7928.6		0.27	
		8:00	24.8	7,914	8149.1		2.97	
		9:00	25.9	8,941	8794.8		1.64	
		10:00	27.1	9,429	9515.7		0.92	
		11:00	27.9	9,915	9741.2		1.75	
		12:00	29.5	9,832	9755.2		0.78	
		13:00	30.5	9,600	9523.7	9332.7	0.79	2.78
		14:00	30.5	9,693	9600.6	9534.3	0.95	1.64
		15:00	30.5	9,571	9636	9636	0.68	0.68
		16:00	30.2	9,629	9720.4	9720.2	0.95	0.95
		17:00	29.7	9,445	9476.6	9476.6	0.33	0.33
		18:00	29.2	8,888	8816.8	8816.7	0.80	0.80
		19:00	28.5	8,877	8871.6	9013.8	0.06	1.54
		20:00	27.8	9,794	9670.7	9819	1.26	0.26
		21:00	27.5	9,721		9476		2.52
		22:00	27.0	9,309		9475.9		1.79
		23:00	26.5	9,117		8952.4		1.81
		0:00	26.2	8,772		8600		1.96
Sunday	4-Jul-04	1:00	26.4	8,365		8228.6		1.63
		2:00	26.2	8,169	7916.7	8085.5	3.09	1.02
	Fz1 % err	3:00	26.2	7,894	7841.6	7841.6	0.66	0.66
	1.25	4:00	26.0	7,677	7841.6	7841.6	2.14	2.14
		5:00	25.7	7,500	7868.7	7868.7	4.92	4.92
	Fz2 % err	6:00	25.5	7,650	7594.8		0.72	
	1.76	7:00	25.3	7,387	7322.9		0.87	
		8:00	26.4	7,156	7137.5		0.26	
		9:00	28.3	7,556	7560		0.05	
		10:00	29.9	7,832	8141.3		3.95	
		11:00	31.3	8,257	8350.9		1.14	
		12:00	32.3	8,387	8383.3		0.04	
		13:00	32.6	8,533	8481.8	8106.8	0.60	4.99
		14:00	33.4	8,673	8600	8600	0.84	0.84
		15:00	31.9	8,562	8600	8600	0.44	0.44
		16:00	26.2	8,440	8383.4	8383.4	0.67	0.67

		17:00	25.3	7,988	7803.8	7803.8	2.31	2.31
		18:00	25.4	7,929	7950	7950	0.26	0.26
		19:00	24.6	8,147	8169.3	8169.3	0.27	0.27
		20:00	24.0	8,991	9030.7	9030.7	0.44	0.44
		21:00	24.6	8,962		9250		3.21
		22:00	24.2	8,810		8903.3		1.06
		23:00	24.1	8,706		8600		1.22
		0:00	23.7	8,285		8600		3.80
Monday	5-Jul-04	1:00	23.7	7,804		7950		1.87
		2:00	23.6	7,626	7675.7	7675.8	0.65	0.65
	Fz1 % err	3:00	23.5	7,374	7137.5	7559.8	3.21	2.52
	2.08	4:00	23.4	7,409	7137.5	7559.8	3.66	2.04
		5:00	23.4	7,307	7137.5	7137.5	2.32	2.32
	Fz2 % err	6:00	23.4	7,466	7940.6		6.36	
	1.37	7:00	23.9	7,580	7948.2		4.86	
		8:00	26.1	8,363	8593.5		2.76	
		9:00	27.6	9,909	9884.1		0.25	
		10:00	29.0	10,678	10523.2		1.45	
		11:00	30.1	11,149	11069.1		0.72	
		12:00	30.9	11,278	11072.4		1.82	
		13:00	32.1	10,803	10473.2	10801.8	3.05	0.01
		14:00	31.7	11,317	11346.6	11346.7	0.26	0.26
		15:00	26.4	11,507	11346.6	11346.7	1.39	1.39
		16:00	25.7	11,426	11221	11221.2	1.79	1.79
		17:00	24.4	11,047	11267.2	10981.1	1.99	0.60
		18:00	24.9	10,242	10108.4	10108.5	1.30	1.30
		19:00	25.1	9,705	9759.3	9757.6	0.56	0.54
		20:00	25.3	10,640	10527.7	10527.8	1.06	1.05
		21:00	25.2	10,398		10504.1		1.02
		22:00	25.1	9,744		9872		1.31
		23:00	24.4	9,413		9250		1.73
		0:00	24.4	8,909		8652.5		2.88
Tuesday	6-Jul-04	1:00	24.0	8,228		8652.5		5.16
		2:00	24.0	8,117	8165.8	7800.3	0.60	3.90
	Fz1 % err	3:00	24.0	7,845	7589.1	7559.9	3.26	3.63
	2.25	4:00	23.8	7,847	7137.5	7559.9	9.04	3.66
		5:00	23.7	7,717	7137.5	7137.5	7.51	7.51
	Fz2 % err	6:00	23.5	7,860	7939.4		1.01	
	2.57	7:00	24.5	8,041	7947.9		1.16	
		8:00	26.8	8,475	8592.6		1.39	
		9:00	27.9	9,952	9882.1		0.70	
		10:00	28.9	10,549	10519.7		0.28	
		11:00	30.3	11,180	11066.3		1.02	
		12:00	30.1	11,331	11070.2		2.30	
		13:00	30.9	10,916	10472.2	10424.8	4.07	4.50
		14:00	28.6	11,377	11344.6	11362.5	0.28	0.13
		15:00	27.8	11,409	11350.1	11362.5	0.52	0.41
		16:00	30.1	11,089	11158.2	11362.5	0.62	2.47
		17:00	30.5	10,775	11158.2	11039	3.56	2.45
		18:00	25.9	10,318	9908.7	10247.4	3.97	0.68
		19:00	25.2	9,988	9893.7	9835.7	0.94	1.52

		20:00	24.3	10,473	10524.9	10530.2	0.50	0.55
		21:00	24.3	10,249		10509	100.00	2.54
		22:00	23.7	9,719		9683.3	100.00	0.37
		23:00	23.8	9,383		9243.4	100.00	1.49
		0:00	24.0	8,845		8600	100.00	2.77
Wednesday	7-Jul-04	1:00	23.0	8,440		8600	100.00	1.90
		2:00	22.6	8,138	8465.1	7800.5	4.02	4.15
	Fz1 % err 2.16	3:00	23.0	7,990	7934.7	7559.9	0.69	5.38
		4:00	23.5	7,849	7214.6	7559.9	8.08	3.68
		5:00	23.4	7,689	7214.6	7137.5	6.17	7.17
	Fz2 % err 2.45	6:00	23.5	8,047	7939		1.34	100.00
		7:00	23.5	8,070	7947.9		1.51	100.00
		8:00	24.7	8,648	8592.3		0.64	100.00
		9:00	26.0	9,977	10061.7		0.85	100.00
		10:00	28.6	10,791	10518.5		2.53	100.00
		11:00	29.9	11,020	11065.1		0.41	100.00
		12:00	30.6	11,173	11069.1		0.93	100.00
		13:00	31.9	10,782	10471.6	10673.5	2.88	1.01
		14:00	30.5	11,204	11343.8	11349	1.25	1.29
		15:00	30.0	11,307	11343.8	11349	0.33	0.37
		16:00	24.2	11,452	11343.8	11349	0.94	0.90
		17:00	25.0	10,888	10423.1	10425	4.27	4.25
		18:00	25.1	10,029	10107	10109.6	0.78	0.80
		19:00	25.1	9,685	9891.7	9788.9	2.13	1.07
		20:00	25.1	10,651	10523.9	10531	1.19	1.13
		21:00	24.8	10,315		10510.6	100.00	1.90
		22:00	25.2	9,906		9677.6	100.00	2.31
		23:00	24.8	9,265		9080.4	100.00	1.99
		0:00	25.0	8,937		8729.7	100.00	2.32
Thursday	8-Jul-04	1:00	25.0	8,379		8769.1	100.00	4.66
		2:00	24.8	7,963	8011.8	8065.7	0.61	1.29
	Fz1 % err 2.16	3:00	24.7	7,925	7841.6	7649.6	1.05	3.48
		4:00	24.5	7,724	7640.4	7560	1.08	2.12
		5:00	24.3	7,763	7318.6	7257.1	5.72	6.52
	Fz2 % err 2.68	6:00	23.9	7,758	7969.7		2.73	100.00
		7:00	23.8	8,127	7947.6		2.21	100.00
		8:00	25.8	8,533	8591.3		0.68	100.00
		9:00	27.7	9,891	9878.9		0.12	100.00
		10:00	28.7	10,470	10514.4		0.42	100.00
		11:00	29.6	10,743	11061.7		2.97	100.00
		12:00	30.8	10,942	11066.3		1.14	100.00
		13:00	31.2	10,507	10470.5	10446.5	0.35	0.58
		14:00	32.0	10,895	11341.3	11358.6	4.10	4.26
		15:00	32.5	10,962	11341.3	11358.6	3.46	3.62
		16:00	30.8	11,064	11341.3	11357.5	2.51	2.65
		17:00	29.3	10,633	11026.9	10863.9	3.70	2.17
		18:00	29.2	9,975	9892.6	9667.8	0.83	3.08
		19:00	28.0	9,873	9344.5	9513.4	5.35	3.64
		20:00	27.4	10,398	10188.3	10105	2.02	2.82
		21:00	26.9	10,199		10221.9	100.00	0.22
		22:00	26.2	9,715		9698.5	100.00	0.17

		23:00	25.9	9,147		9250	100.00	1.13
		0:00	25.4	8,583		8852	100.00	3.13
Friday	9-Jul-04	1:00	25.3	8,271		8851.8	100.00	7.02
		2:00	25.5	8,024	7934.8	8081.8	1.11	0.72
	Fz1 % err 1.49	3:00	25.3	7,740	7841.6	7801.4	1.31	0.79
		4:00	25.3	7,608	7841.6	7801.4	3.07	2.54
		5:00	25.0	7,664	7868.7	7531.3	2.67	1.73
	Fz2 % err 1.79	6:00	24.8	7,747	7573.3		2.24	100.00
		7:00	25.0	7,948	8089.4		1.78	100.00
		8:00	26.9	8,441	8545.8		1.24	100.00
		9:00	28.4	9,964	9869.5		0.95	100.00
		10:00	28.7	10,416	10502.8		0.83	100.00
		11:00	30.0	10,799	10981.5		1.69	100.00
		12:00	30.2	10,915	11017.4		0.94	100.00
		13:00	31.6	10,435	10462.4	10550	0.26	1.10
		14:00	31.4	10,544	10349.5	10225	1.84	3.03
		15:00	32.0	10,959	11091.4	11091.6	1.21	1.21
		16:00	31.0	11,114	11091.4	11362.5	0.20	2.24
		17:00	29.9	10,734	10550	10550	1.71	1.71
		18:00	29.2	10,098	9900	9900	1.96	1.96
		19:00	28.9	9,705	9491.5	9435.6	2.20	2.78
		20:00	28.4	10,375	10478.9	10497.7	1.00	1.18
		21:00	27.6	10,481		10497.7	100.00	0.16
		22:00	26.8	9,779		9880.2	100.00	1.03
		23:00	26.6	9,216		9218.3	100.00	0.02
		0:00	26.3	9,114		9223.9	100.00	1.21
Saturday	10-Jul-04	1:00	26.1	8,519		8600	100.00	0.95
		2:00	25.7	8,277	7983.8	8092.5	3.54	2.23
	Fz1 % err 1.71	3:00	25.1	8,144	7841.6	7841.6	3.71	3.71
		4:00	24.7	7,982	7665.7	7841.6	3.96	1.76
		5:00	24.8	7,744	7885.8	7876.2	1.83	1.71
	Fz2 % err 1.75	6:00	24.5	7,834	8036.2		2.58	100.00
		7:00	24.9	7,870	7928		0.74	100.00
		8:00	26.1	8,280	8148.6		1.59	100.00
		9:00	27.5	9,293	9015.8		2.98	100.00
		10:00	28.8	9,637	9695.2		0.60	100.00
		11:00	25.5	10,106	10295.9		1.88	100.00
		12:00	27.7	10,050	10136.5		0.86	100.00
		13:00	26.3	9,590	9564.8	9436.3	0.26	1.60
		14:00	26.5	9,566	9250	9250	3.30	3.30
		15:00	26.5	9,225	9250	9250	0.27	0.27
		16:00	26.5	9,331	9250	9250	0.87	0.87
		17:00	26.9	8,775	8713.4	8713.3	0.70	0.70
		18:00	26.3	8,564	8453.4	8228.5	1.29	3.92
		19:00	25.8	8,634	8600	8600	0.39	0.39
		20:00	25.3	9,363	9250	9250	1.21	1.21
		21:00	25.0	9,406		9174.6	100.00	2.46
		22:00	24.6	9,025		9174.6	100.00	1.66
		23:00	24.1	8,634		8600	100.00	0.39
		0:00	24.2	8,236		8025.4	100.00	2.56
Sunday	11-Jul-04	1:00	24.0	7,777		7950	100.00	2.22

		2:00	23.8	7,465	7675.7	7677.4	2.82	2.85
	Fz1 % err	3:00	23.7	7,306	7137.5	7559.4	2.31	3.47
	1.18	4:00	23.4	7,140	7137.5	7559.4	0.04	5.87
		5:00	23.2	7,098	7137.5	7677.4	0.56	8.16
	Fz2 % err	6:00	23.0	7,221	7137.5		1.16	100.00
	2.32	7:00	23.4	6,948	6935.3		0.18	100.00
		8:00	25.3	6,973	6935.3		0.54	100.00
		9:00	27.9	7,471	7413.5		0.77	100.00
		10:00	29.5	7,849	7910.9		0.79	100.00
		11:00	30.8	8,376	8125		3.00	100.00
		12:00	30.0	8,260	8383.4		1.49	100.00
		13:00	29.7	8,142	8372	8026.2	2.82	1.42
		14:00	28.8	8,212	8372	8292	1.95	0.97
		15:00	25.8	8,150	8169.4	8169.3	0.24	0.24
		16:00	26.1	8,147	8169.4	8169.3	0.27	0.27
		17:00	27.6	7,746	7747.3	7794.4	0.02	0.62
		18:00	28.4	7,846	7950	7950	1.33	1.33
		19:00	27.5	8,066	8086.3	8054.1	0.25	0.15
		20:00	27.0	8,918	9094.9	9094.9	1.98	1.98
		21:00	26.8	9,072		9231.1	100.00	1.75
		22:00	26.5	8,810		8600	100.00	2.38
		23:00	26.0	8,639		8600	100.00	0.45
		0:00	25.8	8,049		8470.1	100.00	5.23
Monday	12-Jul-04	1:00	25.5	7,792		7950	100.00	2.03
		2:00	25.5	7,456	7815.9	7820	4.83	4.88
	Fz1 % err	3:00	25.0	7,116	7841.6	7841.6	10.20	10.20
	3.93	4:00	25.0	7,132	7634.4	7787.5	7.04	9.19
		5:00	24.9	6,888	7419.1	7521.6	7.71	9.20
	Fz2 % err	6:00	24.7	7,125	8070.7		13.27	100.00
	3.33	7:00	24.8	7,405	8304.2		12.14	100.00
		8:00	26.2	8,125	8594.6		5.78	100.00
		9:00	28.4	9,640	9887		2.56	100.00
		10:00	29.5	10,488	10527.9		0.38	100.00
		11:00	31.3	11,018	11073.1		0.50	100.00
		12:00	32.7	11,080	11075.9		0.04	100.00
		13:00	33.1	10,816	10746.5	10925.6	0.64	1.01
		14:00	33.3	11,287	11349.5	11349.5	0.55	0.55
		15:00	32.7	11,179	11349.5	11349.5	1.53	1.53
		16:00	31.7	11,254	11415.7	11415.7	1.44	1.44
		17:00	31.7	10,919	10863.9	10863.9	0.50	0.50
		18:00	30.3	10,173	10321.2	10863.9	1.46	6.79
		19:00	28.3	9,554	9806.4	9877	2.64	3.38
		20:00	27.7	10,425	10580.3	10440.9	1.49	0.15
		21:00	27.0	10,182		10345.7	100.00	1.61
		22:00	26.7	9,858		9756.7	100.00	1.03
		23:00	26.1	9,403		9286.4	100.00	1.24
		0:00	25.9	8,692		8852	100.00	1.84
Tuesday	13-Jul-04	1:00	25.8	8,419		8852	100.00	5.14
		2:00	25.3	8,121	7938.7	8103.4	2.24	0.22
	Fz1 % err	3:00	25.2	7,824	7841.6	7841.6	0.22	0.22

	1.08	4:00	25.0	7,532	7724.3	7724.3	2.55	2.55
		5:00	24.2	7,623	7419.1	7419.1	2.67	2.67
	Fz2 % err	6:00	24.1	7,854	7942.3		1.12	100.00
	1.25	7:00	24.4	8,019	7948.5		0.88	100.00
		8:00	27.0	8,790	8594.6		2.22	100.00
		9:00	29.2	9,936	9887		0.49	100.00
		10:00	30.9	10,628	10533.7		0.89	100.00
		11:00	30.4	11,276	11349.5		0.65	100.00
		12:00	30.7	11,264	11349.5		0.76	100.00
		13:00	30.3	10,698	10698.1	10785	0.00	0.81
		14:00	28.8	11,396	11349.5	11356.5	0.41	0.35
		15:00	25.2	11,346	11353.4	11362.5	0.07	0.15
		16:00	25.1	11,153	11202.3	11181.3	0.44	0.25
		17:00	25.5	10,910	11091.7	10894.8	1.67	0.14
		18:00	23.4	10,273	10156.2	10108.6	1.14	1.60
		19:00	23.2	9,735	9636.5	9683.3	1.01	0.53
		20:00	23.3	10,438	10550	10550	1.07	1.07
		21:00	23.4	10,326		10550	100.00	2.17
		22:00	23.5	9,848		9683.3	100.00	1.67
		23:00	23.6	9,131		9242.6	100.00	1.22
		0:00	23.7	8,645		8600	100.00	0.52
Wednesday	14-Jul-04	1:00	23.8	8,108		8600	100.00	6.07
		2:00	23.9	7,825	7970.2	7800.2	1.86	0.32
	Fz1 % err	3:00	24.0	7,759	7394.1	7559.9	4.70	2.57
	1.87	4:00	24.2	7,626	7137.5	7559.9	6.41	0.87
		5:00	23.9	7,512	7137.5	7137.5	4.99	4.99
	Fz2 % err	6:00	23.5	7,707	7940.5		3.03	100.00
	1.86	7:00	24.0	7,889	7948.2		0.75	100.00
		8:00	26.5	8,388	8593.4		2.45	100.00
		9:00	28.6	9,864	9883.9		0.20	100.00
		10:00	30.5	10,581	10522.9		0.55	100.00
		11:00	31.5	11,190	11343.6		1.37	100.00
		12:00	32.0	11,180	11346.4		1.49	100.00
		13:00	31.7	10,796	10748.4	10693.4	0.44	0.95
		14:00	25.0	11,198	11346.4	11348.8	1.33	1.35
		15:00	25.2	10,983	10981.6	11004.2	0.01	0.19
		16:00	25.7	11,219	11211.5	11083.4	0.07	1.21
		17:00	25.9	10,630	11046.5	11085.7	3.92	4.29
		18:00	25.2	10,072	10216.2	10254.5	1.43	1.81
		19:00	25.1	9,835	9877.1	9826	0.43	0.09
		20:00	25.1	10,523	10527.5	10530.8	0.04	0.07
		21:00	24.7	10,220		10510.2	100.00	2.84
		22:00	24.8	10,037		9677.6	100.00	3.58
		23:00	24.8	9,272		9250	100.00	0.24
		0:00	24.6	8,715		8731	100.00	0.18
Thursday	15-Jul-04	1:00	24.7	8,230		8689.3	100.00	5.58
		2:00	24.2	7,965	8009.9	8043.5	0.56	0.99
	Fz1 % err	3:00	23.8	7,691	7592.5	7560	1.28	1.70
	2.19	4:00	23.6	7,619	7137.5	7560	6.32	0.77
		5:00	23.1	7,525	7137.5	7137.5	5.15	5.15

	Fz2 % err 2.19	6:00	23.1	7,641	7939.4		3.91	100.00
		7:00	23.4	7,909	7947.9		0.49	100.00
		8:00	25.2	8,511	8592.6		0.96	100.00
		9:00	27.6	10,063	9882		1.80	100.00
		10:00	29.2	10,597	10519.7		0.73	100.00
		11:00	30.2	11,026	11066.1		0.36	100.00
		12:00	31.1	11,088	11070		0.16	100.00
		13:00	26.0	10,635	10472.2	10581.8	1.53	0.50
		14:00	24.4	11,019	11182.5	11035.9	1.48	0.15
		15:00	23.8	11,069	11119.5	11143.8	0.46	0.68
		16:00	24.9	11,003	11197.7	11197.7	1.77	1.77
		17:00	26.1	10,434	11117.3	10961.4	6.55	5.05
		18:00	26.2	9,723	10265.3	10344.9	5.58	6.40
		19:00	25.7	9,719	9893.7	9895.7	1.80	1.82
		20:00	25.2	10,445	10524.9	10533.1	0.76	0.84
		21:00	24.7	10,197		10514.7	100.00	3.12
		22:00	24.5	9,676		9678.2	100.00	0.02
		23:00	24.4	9,131		9250	100.00	1.30
		0:00	24.3	8,518		8640.4	100.00	1.44
Friday	16-Jul-04	1:00	24.1	8,197		8620.4	100.00	5.17
		2:00	24.0	7,957	8117.6	7800.3	2.02	1.97
	Fz1 % err 1.83	3:00	23.8	7,530	7538.8	7560	0.12	0.40
		4:00	23.5	7,567	7137.5	7560	5.68	0.09
		5:00	23.4	7,456	7929.7	7137.5	6.35	4.27
	Fz2 % err 2.21	6:00	23.3	7,783	7929.7		1.88	100.00
		7:00	23.6	7,875	7946		0.90	100.00
		8:00	25.6	8,420	8545.8		1.49	100.00
		9:00	27.8	9,748	9865.5		1.21	100.00
		10:00	28.9	10,359	10496.8		1.33	100.00
		11:00	29.6	10,928	10977.3		0.45	100.00
		12:00	30.9	10,824	11007.9		1.70	100.00
		13:00	31.7	10,356	10451.4	10550	0.92	1.87
		14:00	30.5	10,444	10496	10219.8	0.50	2.15
		15:00	24.2	10,794	10915.8	10953.1	1.13	1.47
		16:00	23.7	10,908	11091.4	11091.6	1.68	1.68
		17:00	23.7	10,146	10550	10550	3.98	3.98
		18:00	24.0	9,649	9683.1	9683.2	0.35	0.35
		19:00	24.2	9,488	9250	9250	2.51	2.51
		20:00	24.0	10,224	10278	10277.6	0.53	0.52
		21:00	24.2	9,911		9683.1	100.00	2.30
		22:00	24.0	9,554		9250	100.00	3.18
		23:00	24.0	8,970		8600	100.00	4.12
		0:00	24.0	8,469		8600	100.00	1.55
Saturday	17-Jul-04	1:00	22.8	8,112		7950	100.00	2.00
		2:00	22.9	7,699	7976.8	7690	3.61	0.12
	Fz1 % err 4.08	3:00	23.0	7,499	7400.6	7543.7	1.31	0.60
		4:00	23.0	7,371	7137.5	7543.7	3.17	2.34
		5:00	23.0	7,464	7675.7	7137.5	2.84	4.37
	Fz2 % err 2.13	6:00	22.9	7,415	7922		6.84	100.00
		7:00	23.2	7,429	7922		6.64	100.00

		8:00	23.5	7,486	8142.9		8.78	100.00
		9:00	25.4	8,506	8816.7		3.65	100.00
		10:00	27.4	8,961	9519.5		6.23	100.00
		11:00	28.7	9,558	9994.2		4.56	100.00
		12:00	29.3	9,590	9994.2		4.21	100.00
		13:00	29.6	9,249	9504.5	9144.1	2.76	1.13
		14:00	29.7	9,282	9497.4	9225.4	2.32	0.61
		15:00	30.2	9,245	9636.3	9628.8	4.23	4.15
		16:00	30.4	9,331	9720.6	9645.7	4.18	3.37
		17:00	29.5	9,013	9476.8	9394.5	5.15	4.23
		18:00	28.3	8,692	8816.8	8816.7	1.44	1.43
		19:00	27.2	8,701	8600	8771	1.16	0.80
		20:00	26.7	9,675	9250	9250	4.39	4.39
		21:00	26.3	9,418		9250	100.00	1.78
		22:00	25.8	9,106		9150.1	100.00	0.48
		23:00	25.4	8,622		8600	100.00	0.26
		0:00	25.1	8,253		8600	100.00	4.20
Sunday	18-Jul-04	1:00	24.4	7,870		8204.3	100.00	4.25
		2:00	24.2	7,661	7882.6	8015.3	2.89	4.62
	Fz1 % err	3:00	23.9	7,371	7313.7	7559.9	0.78	2.56
	2.12	4:00	23.7	7,112	7137.5	7559.9	0.36	6.30
		5:00	23.7	6,995	7137.5	7675.9	2.04	9.73
	Fz2 % err	6:00	23.5	7,089	7137.5		0.68	100.00
	3.11	7:00	23.4	6,955	6935.3		0.28	100.00
		8:00	25.4	6,824	6935.3		1.63	100.00
		9:00	27.8	7,208	7413.7		2.85	100.00
		10:00	29.9	7,694	7911		2.82	100.00
		11:00	31.0	8,108	8313		2.53	100.00
		12:00	32.4	8,371	8383.4		0.15	100.00
		13:00	32.8	8,106	8569	8171.8	5.71	0.81
		14:00	32.7	8,324	8600	8600	3.32	3.32
		15:00	32.2	8,224	8600	8600	4.57	4.57
		16:00	32.5	8,416	8497.3	8383.3	0.97	0.39
		17:00	31.8	8,223	7950	7950	3.32	3.32
		18:00	30.5	8,034	7950	7950	1.05	1.05
		19:00	28.6	7,817	7950	7950	1.70	1.70
		20:00	28.0	9,008	9250	9250	2.69	2.69
		21:00	26.6	8,979		9170.4	100.00	2.13
		22:00	25.9	8,759		8600	100.00	1.82
		23:00	25.7	8,602		8600	100.00	0.02
		0:00	25.3	8,190		8481.8	100.00	3.56
Monday	19-Jul-04	1:00	24.9	7,750		7950	100.00	2.58
		2:00	24.3	7,491	7848.9	7839	4.78	4.65
	Fz1 % err	3:00	24.2	7,141	7753.7	7841.6	8.58	9.81
	2.95	4:00	23.8	7,110	7137.5	7559.9	0.39	6.33
		5:00	23.8	7,076	7137.5	7137.5	0.87	0.87
	Fz2 % err	6:00	24.0	7,435	7938.3		6.77	100.00
	2.99	7:00	24.6	7,485	7947.7		6.18	100.00
		8:00	27.7	8,016	8591.8		7.18	100.00
		9:00	28.7	9,874	9880.2		0.06	100.00
		10:00	30.2	10,589	10516.4		0.69	100.00

		11:00	30.0	11,105	11339.2		2.11	100.00
		12:00	31.2	11,033	11342.6		2.81	100.00
		13:00	32.3	10,752	10694.8	10527.6	0.53	2.09
		14:00	30.7	11,191	11342.6	11351.2	1.35	1.43
		15:00	30.3	11,024	11342.6	11351.2	2.89	2.97
		16:00	30.7	11,074	11342.6	11349.5	2.43	2.49
		17:00	31.6	10,834	11068.9	10892.8	2.17	0.54
		18:00	30.5	10,130	10316.4	10863.9	1.84	7.24
		19:00	28.8	9,436	9806.6	9877	3.93	4.67
		20:00	27.6	10,519	10575.3	10440.9	0.54	0.74
		21:00	27.3	10,176		10345.7	100.00	1.67
		22:00	27.0	9,661		9756.7	100.00	0.99
		23:00	26.5	9,326		9392.1	100.00	0.71
		0:00	26.2	8,946		8852	100.00	1.05
Tuesday	20-Jul-04	1:00	25.7	8,233		8852	100.00	7.52
		2:00	25.6	8,062	7890.4	8099.4	2.13	0.46
	Fz1 % err	3:00	25.7	7,686	7841.6	7841.6	2.02	2.02
	2.76	4:00	25.6	7,632	7841.6	7841.6	2.75	2.75
		5:00	22.0	7,560	7719.3	7685.5	2.11	1.66
	Fz2 % err	6:00	22.3	7,724	7942.9		2.83	100.00
	2.76	7:00	22.5	7,705	7948.6		3.16	100.00
		8:00	23.1	8,443	8595		1.80	100.00
		9:00	23.5	9,748	10538.6		8.11	100.00
		10:00	24.7	10,318	10541		2.16	100.00
		11:00	27.0	10,669	10550		1.12	100.00
		12:00	28.0	10,727	10550		1.65	100.00
		13:00	24.5	10,353	10550	10550	1.90	1.90
		14:00	24.8	10,703	11478.4	11362.5	7.24	6.16
		15:00	26.0	10,967	10939.9	11055.5	0.25	0.81
		16:00	27.1	10,903	11025.9	10896.1	1.13	0.06
		17:00	27.0	10,476	11047.9	11047.9	5.46	5.46
		18:00	26.4	9,691	9880.2	9778	1.95	0.90
		19:00	25.8	9,658	9880.2	9890.1	2.30	2.40
		20:00	25.1	10,238	10473.2	10510.8	2.30	2.66
		21:00	24.9	10,173		10469.2	100.00	2.91
		22:00	24.6	9,698		9890.1	100.00	1.98
		23:00	24.5	8,974		9250	100.00	3.08
		0:00	24.0	8,380		8734.7	100.00	4.23
Wednesday	21-Jul-04	1:00	23.7	8,106		8600	100.00	6.09
		2:00	23.6	7,839	7966.4	7800.2	1.63	0.49
	Fz1 % err	3:00	23.5	7,550	7390.8	7560	2.11	0.13
	2.58	4:00	23.2	7,435	7137.5	7560	4.00	1.68
		5:00	23.2	7,429	7137.5	7137.5	3.92	3.92
	Fz2 % err	6:00	23.1	7,562	7940.6		5.01	100.00
	2.34	7:00	23.5	7,789	7948.2		2.04	100.00
		8:00	25.3	8,272	8593.4		3.89	100.00
		9:00	27.4	9,834	9884		0.51	100.00
		10:00	28.8	10,376	10523		1.42	100.00
		11:00	29.5	10,964	11069		0.96	100.00
		12:00	29.7	10,808	11072.4		2.45	100.00
		13:00	30.0	10,471	10581.6	10561	1.06	0.86

		14:00	28.7	11,004	11346.5	11357.8	3.11	3.22
		15:00	29.4	11,033	11351.4	11362.5	2.89	2.99
		16:00	29.5	11,115	11349.7	11362.5	2.11	2.23
		17:00	29.2	10,563	11256.5	11288.7	6.57	6.87
		18:00	28.6	9,958	9894.3	9667.8	0.64	2.91
		19:00	28.0	9,659	9344.4	9513.3	3.26	1.51
		20:00	27.1	10,333	10190.5	10105.3	1.38	2.20
		21:00	26.0	10,184		10329.3	100.00	1.43
		22:00	25.6	9,702		9895.7	100.00	2.00
		23:00	25.5	9,255		9250	100.00	0.05
		0:00	25.5	8,746		8852	100.00	1.21
Thursday	22-Jul-04	1:00	25.2	8,187		8852	100.00	8.12
		2:00	24.7	7,861	7916.2	8074.2	0.70	2.71
	Fz1 % err	3:00	24.7	7,751	7841.6	7724.3	1.17	0.34
	1.21	4:00	24.2	7,551	7559.9	7560	0.12	0.12
		5:00	24.2	7,470	7137.5	7137.5	4.45	4.45
	Fz2 % err	6:00	23.9	7,704	7940		3.06	100.00
	1.69	7:00	24.4	7,900	7948.1		0.61	100.00
		8:00	25.8	8,638	8593.1		0.52	100.00
		9:00	28.7	9,908	9883.1		0.25	100.00
		10:00	30.5	10,654	10521.5		1.24	100.00
		11:00	31.7	11,105	11342.6		2.14	100.00
		12:00	32.0	11,146	11345.6		1.79	100.00
		13:00	32.5	10,690	10770	10674.7	0.75	0.14
		14:00	32.4	11,197	11345.6	11349.5	1.33	1.36
		15:00	32.4	11,222	11345.6	11349.5	1.10	1.14
		16:00	32.0	11,306	11345.4	11349.5	0.35	0.38
		17:00	31.3	10,920	10934	10863.9	0.13	0.51
		18:00	29.6	10,115	10318.5	10745.4	2.01	6.23
		19:00	28.6	9,853	9905.9	9985.2	0.54	1.34
		20:00	28.0	10,540	10465.8	10468.6	0.70	0.68
		21:00	27.8	10,441		10404.3	100.00	0.35
		22:00	27.1	9,817		9800.3	100.00	0.17
		23:00	26.5	9,439		9439.4	100.00	0.00
		0:00	26.0	8,913		8851.9	100.00	0.69
Friday	23-Jul-04	1:00	26.0	8,527		8851.9	100.00	3.81
		2:00	26.5	8,071	7987.5	8109.6	1.03	0.48
	Fz1 % err	3:00	25.5	8,014	7841.6	7841.6	2.15	2.15
	2.13	4:00	25.2	7,716	7841.6	7841.6	1.63	1.63
		5:00	25.3	7,641	7879.3	7501.6	3.12	1.82
	Fz2 % err	6:00	23.9	7,821	7692		1.65	100.00
	1.94	7:00	22.2	7,964	8068.9		1.32	100.00
		8:00	22.5	8,464	8545.8		0.97	100.00
		9:00	22.7	9,832	10525.7		7.06	100.00
		10:00	23.8	10,113	10530.9		4.13	100.00
		11:00	23.7	10,688	11091.6		3.78	100.00
		12:00	24.6	10,666	10550		1.09	100.00
		13:00	26.5	10,236	10054.7	10333.3	1.77	0.95
		14:00	27.7	10,170	9973.4	9973.5	1.93	1.93
		15:00	29.3	10,605	10368.9	10359.5	2.23	2.31
		16:00	29.9	10,768	10550	10550	2.02	2.02

		17:00	30.6	10,511	10550	10550	0.37	0.37
		18:00	30.3	9,876	9900	9900	0.24	0.24
		19:00	29.3	9,609	9683.4	9683.3	0.77	0.77
		20:00	28.5	10,228	10550	10550	3.15	3.15
		21:00	27.8	10,175		10550	100.00	3.69
		22:00	27.2	9,707		9900	100.00	1.99
		23:00	26.9	9,142		9212.2	100.00	0.77
		0:00	26.5	8,790		9218.8	100.00	4.88
Saturday	24-Jul-04	1:00	26.0	8,412		8600	100.00	2.23
		2:00	26.0	7,991	7935.8	8085.2	0.69	1.18
	Fz1 % err	3:00	25.7	7,863	7841.6	7841.6	0.27	0.27
	2.87	4:00	25.6	7,725	7841.6	7841.6	1.51	1.51
		5:00	22.0	7,511	7868.7	7868.7	4.76	4.76
	Fz2 % err	6:00	21.7	7,550	7928.8		5.02	100.00
	2.15	7:00	21.9	7,601	7928.8		4.31	100.00
		8:00	22.3	7,921	8149.4		2.88	100.00
		9:00	23.5	9,140	8816.7		3.54	100.00
		10:00	24.1	9,753	9674.6		0.80	100.00
		11:00	25.9	10,045	9683.2		3.60	100.00
		12:00	27.8	9,930	9477.7		4.55	100.00
		13:00	29.6	9,459	9092.6	9407.9	3.87	0.54
		14:00	30.6	9,613	9173.4	9476.7	4.57	1.42
		15:00	31.3	9,517	9636.1	9554.7	1.25	0.40
		16:00	30.6	9,624	9720.3	9642.4	1.00	0.19
		17:00	29.9	9,009	9476.6	9390.9	5.19	4.24
		18:00	29.3	8,634	8816.8	8816.7	2.12	2.12
		19:00	27.6	8,489	8860.3	8895.7	4.37	4.79
		20:00	27.1	9,666	9650.5	9592.3	0.16	0.76
		21:00	26.3	9,528		9220.3	100.00	3.23
		22:00	25.6	9,132		8750.1	100.00	4.18
		23:00	24.8	8,822		8600	100.00	2.52
		0:00	24.7	8,330		8507.3	100.00	2.13
Sunday	25-Jul-04	1:00	24.8	7,926		8187.8	100.00	3.30
		2:00	24.5	7,793	7857.1	8053	0.82	3.34
	Fz1 % err	3:00	24.6	7,708	7665.8	7841.6	0.55	1.73
	1.99	4:00	24.5	7,278	7521.6	7665.5	3.35	5.32
		5:00	24.8	7,178	7300	7895.8	1.70	10.00
	Fz2 % err	6:00	24.9	7,156	7271.5		1.61	100.00
	2.74	7:00	25.0	7,076	7036		0.57	100.00
		8:00	27.1	6,977	7036		0.85	100.00
		9:00	28.4	7,355	7481.3		1.72	100.00
		10:00	29.7	7,724	8045.9		4.17	100.00
		11:00	29.8	8,263	8363.3		1.21	100.00
		12:00	31.0	8,244	8383.4		1.69	100.00
		13:00	32.2	8,161	8383.4	8043.2	2.73	1.44
		14:00	32.0	8,388	8600	8427.3	2.53	0.47
		15:00	31.9	8,240	8600	8600	4.37	4.37
		16:00	31.8	8,266	8541	8383.2	3.33	1.42
		17:00	31.4	8,146	7950	7950	2.41	2.41
		18:00	31.3	7,822	7950	7950	1.64	1.64
		19:00	30.3	7,825	7950	7950	1.60	1.60

		20:00	29.4	9,163	9250	9250	0.95	0.95
		21:00	28.5	9,076		8816.8	100.00	2.86
		22:00	27.8	8,756		8658.9	100.00	1.11
		23:00	27.5	8,781		8490.5	100.00	3.31
		0:00	27.0	8,268		8383.2	100.00	1.39
Monday	26-Jul-04	1:00	26.2	7,985		7950	100.00	0.44
		2:00	25.5	7,550	7803.7	7810.7	3.36	3.45
	Fz1 % err 2.27	3:00	24.2	7,417	7841.6	7841.6	5.72	5.72
		4:00	23.6	7,202	7137.5	7559.9	0.90	4.97
		5:00	23.3	7,248	7137.5	7137.5	1.52	1.52
	Fz2 % err 2.25	6:00	23.4	7,418	7942.3		7.07	100.00
		7:00	23.9	7,702	7948.5		3.20	100.00
		8:00	24.8	8,534	8594.6		0.71	100.00
		9:00	27.6	9,904	10120.1		2.18	100.00
		10:00	28.9	10,560	10527.9		0.30	100.00
		11:00	29.7	11,239	11073.1		1.48	100.00
		12:00	29.9	11,053	11075.9		0.21	100.00
		13:00	29.9	10,921	10573.2	10666.2	3.18	2.33
		14:00	30.5	11,195	11349.5	11358.1	1.38	1.46
		15:00	31.1	11,244	11349.5	11358.1	0.94	1.01
		16:00	31.1	11,125	10837.5	11358.1	2.58	2.10
		17:00	30.3	10,631	10785.3	10864.9	1.45	2.20
		18:00	29.4	9,938	9949.1	9770.8	0.11	1.68
		19:00	28.7	9,852	9418.1	9567.5	4.40	2.89
		20:00	27.9	10,465	10220.6	10138	2.34	3.12
		21:00	27.3	10,123		10143.5	100.00	0.20
		22:00	26.9	9,858		9559.6	100.00	3.03
		23:00	26.8	9,447		9357.7	100.00	0.95
		0:00	26.3	8,744		8852	100.00	1.24
Tuesday	27-Jul-04	1:00	26.1	8,381		8852	100.00	5.62
		2:00	25.7	8,042	7923	8109.7	1.48	0.84
	Fz1 % err 1.64	3:00	25.2	7,808	7841.6	7841.6	0.43	0.43
		4:00	24.2	7,661	7693.5	7724.3	0.42	0.83
		5:00	24.5	7,508	7137.5	7137.5	4.93	4.93
	Fz2 % err 2.20	6:00	24.3	7,845	7997.2		1.94	100.00
		7:00	24.7	7,977	8029.9		0.66	100.00
		8:00	27.0	8,697	8595		1.17	100.00
		9:00	27.7	9,889	9887.9		0.01	100.00
		10:00	28.9	10,343	10527.9		1.79	100.00
		11:00	30.1	10,873	11073.1		1.84	100.00
		12:00	30.9	10,878	11076		1.82	100.00
		13:00	32.1	10,493	10474.9	10394.4	0.17	0.94
		14:00	31.5	10,985	11349.5	11352.5	3.32	3.35
		15:00	30.8	11,219	11349.5	11352.5	1.16	1.19
		16:00	30.7	11,274	11047.3	11352.5	2.01	0.70
		17:00	30.9	10,865	10944.7	10865.9	0.73	0.01
		18:00	30.5	10,171	10181.3	10389.6	0.10	2.15
		19:00	30.0	9,812	9678.7	9768.4	1.36	0.44
		20:00	29.4	10,355	10950.9	10886	5.75	5.13
		21:00	28.4	10,339		10348.8	100.00	0.09
		22:00	27.7	9,715		9914.6	100.00	2.05

		23:00	27.2	9,328		9920.8	100.00	6.36
		0:00	27.4	8,925		9128.3	100.00	2.28
Wednesday	28-Jul-04	1:00	27.3	8,374		8851.9	100.00	5.71
		2:00	26.9	7,991	7922.5	8107.6	0.86	1.46
	Fz1 % err	3:00	26.5	7,906	7841.6	7841.6	0.81	0.81
	1.85	4:00	26.0	7,683	7841.6	7841.6	2.06	2.06
		5:00	26.0	7,718	7868.7	7868.7	1.95	1.95
	Fz2 % err	6:00	25.7	7,828	8163.6		4.29	100.00
	1.67	7:00	26.0	8,032	8595.3		7.01	100.00
		8:00	26.5	8,516	8668.1		1.79	100.00
		9:00	28.5	10,140	9960.6		1.77	100.00
		10:00	29.9	10,689	10530.9		1.48	100.00
		11:00	30.4	11,223	11143.9		0.70	100.00
		12:00	30.8	11,089	11172		0.75	100.00
		13:00	29.5	10,717	10545.9	10582.9	1.60	1.25
		14:00	29.1	11,041	11350.4	11357.8	2.80	2.87
		15:00	27.9	11,222	11350.4	11357.8	1.14	1.21
		16:00	27.7	11,333	11188.4	11195.4	1.28	1.21
		17:00	27.2	10,925	11092.6	11092.6	1.53	1.53
		18:00	26.9	10,140	10132.5	9888.4	0.07	2.48
		19:00	26.3	10,024	9736	9772.1	2.87	2.51
		20:00	26.1	10,562	10531.7	10531.7	0.29	0.29
		21:00	25.9	10,350		10524.1	100.00	1.68
		22:00	25.6	9,969		9895.4	100.00	0.74
		23:00	25.3	9,195		9250	100.00	0.60
		0:00	25.1	8,825		8817.5	100.00	0.08
Thursday	29-Jul-04	1:00	24.2	8,244		8781.5	100.00	6.52
		2:00	23.9	7,889	8190.6	7800.4	3.82	1.12
	Fz1 % err	3:00	23.0	7,709	7615.2	7560	1.22	1.93
	2.53	4:00	23.2	7,507	7137.5	7560	4.92	0.71
		5:00	23.0	7,719	7137.5	7137.5	7.53	7.53
	Fz2 % err	6:00	22.9	7,670	7939.3		3.51	100.00
	2.63	7:00	23.0	8,061	7947.9		1.40	100.00
		8:00	25.2	8,444	8592.5		1.76	100.00
		9:00	26.6	9,936	9881.8		0.55	100.00
		10:00	29.0	10,370	10519.3		1.44	100.00
		11:00	29.9	10,768	11065.7		2.76	100.00
		12:00	31.2	10,753	11069.7		2.95	100.00
		13:00	31.2	10,436	10472.2	10303.4	0.35	1.27
		14:00	31.0	10,904	11344.3	11359.3	4.04	4.18
		15:00	31.3	10,972	11344.3	11359.2	3.39	3.53
		16:00	31.7	11,033	10683.4	11359.2	3.17	2.96
		17:00	30.7	10,597	10664.2	10866.7	0.63	2.55
		18:00	29.1	9,790	9983.5	10208.6	1.98	4.28
		19:00	28.3	9,540	9470.3	9801.7	0.73	2.74
		20:00	28.0	10,446	10237.8	10299.7	1.99	1.40
		21:00	27.3	10,257		10268.1	100.00	0.11
		22:00	26.7	9,726		9683.4	100.00	0.44
		23:00	26.4	9,140		9283.9	100.00	1.57
		0:00	25.9	8,691		8851.9	100.00	1.85

Friday	30-Jul-04	1:00	25.4	8,138		8851.9	100.00	8.77
		2:00	24.9	7,888	7882.5	8085.4	0.07	2.50
	Fz1 % err	3:00	24.6	7,765	7841.6	7841.5	0.99	0.99
	1.88	4:00	24.4	7,458	7439.3	7560	0.25	1.37
		5:00	24.0	7,539	7926.8	7221.9	5.14	4.21
	Fz2 % err	6:00	24.0	7,555	7825.1		3.58	100.00
	2.14	7:00	24.4	7,835	7986.3		1.93	100.00
		8:00	26.3	8,249	8545.8		3.60	100.00
		9:00	27.4	9,642	9871.9		2.38	100.00
		10:00	30.0	10,147	10506.7		3.54	100.00
		11:00	30.7	10,753	11253.6		4.66	100.00
		12:00	31.5	10,855	11058.7		1.88	100.00
		13:00	32.3	10,282	10535.5	10550	2.47	2.61
		14:00	30.3	10,549	10574.9	10459.5	0.25	0.85
		15:00	24.4	10,860	10951.9	10958.1	0.85	0.90
		16:00	25.4	10,832	11063.2	11091.6	2.13	2.40
		17:00	25.8	10,538	10503.8	10550	0.32	0.11
		18:00	25.4	9,738	9665.7	9683.4	0.74	0.56
		19:00	25.3	9,786	9870.4	9900	0.86	1.16
		20:00	24.7	10,260	10247.9	10241.1	0.12	0.18
		21:00	24.6	10,287		9833.5	100.00	4.41
		22:00	24.7	9,530		9202.5	100.00	3.44
		23:00	24.7	9,064		9202.5	100.00	1.53
		0:00	24.3	8,641		8600	100.00	0.47
Saturday	31-Jul-04	1:00	24.3	8,190		8256.4	100.00	0.81
		2:00	24.3	8,023	8136.1	8063.1	1.41	0.50
	Fz1 % err	3:00	24.1	7,724	7527.2	7635.7	2.55	1.14
	2.91	4:00	24.4	7,422	7137.5	7560	3.83	1.86
		5:00	23.9	7,488	7798.9	7868.7	4.15	5.08
	Fz2 % err	6:00	23.8	7,439	7919.9		6.46	100.00
	2.19	7:00	24.0	7,661	7919.9		3.38	100.00
		8:00	24.5	8,138	8140.9		0.04	100.00
		9:00	26.4	9,406	8785.8		6.59	100.00
		10:00	28.1	9,816	9514.1		3.08	100.00
		11:00	29.2	10,334	10066		2.59	100.00
		12:00	30.2	10,504	10078.6		4.05	100.00
		13:00	30.2	9,745	9765.5	9879.8	0.21	1.38
		14:00	30.3	9,924	9720.2	9720.4	2.05	2.05
		15:00	26.8	9,691	9635.9	9604.6	0.57	0.89
		16:00	26.3	9,378	9216	9230.3	1.73	1.57
		17:00	27.5	9,187	8702.6	8707.2	5.27	5.22
		18:00	27.7	8,828	8600	8507.2	2.58	3.63
		19:00	27.0	8,855	8600	8600	2.88	2.88
		20:00	26.5	9,424	9250	9250	1.85	1.85
		21:00	26.5	9,519		9204.5	100.00	3.30
		22:00	26.3	9,187		9223.9	100.00	0.40
		23:00	26.1	8,740		8600	100.00	1.60
		0:00	26.0	8,348		8600	100.00	3.02

APPENDIX E

GANTT CHART

No	Detail / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Meeting supervisor														
2	Preliminary research and project planning														
3	Submission of Preliminary Report (Initial Proposal)														
4	Project progress														
5	Submission of Progress Report														
6	Meeting with TNB's forecaster														
8	Analyzing and research on data														
9	Submission of Interim Final Draft														
10	Oral Presentation														
11	Submission of Project Interim Report														

Gantt chart of the project (FYP I)

No	Detail / Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Meeting supervisor														
2	Project research														
3	Submission of Progress Report I														
4	Project progress														
5	Submission of Progress Report II														
6	Meeting with TNB's personnel														
9	Submission of Dissertation Final Draft														
11	Submission of Project Dissertation (soft cover)														

Gantt chart of the project (FYP II)